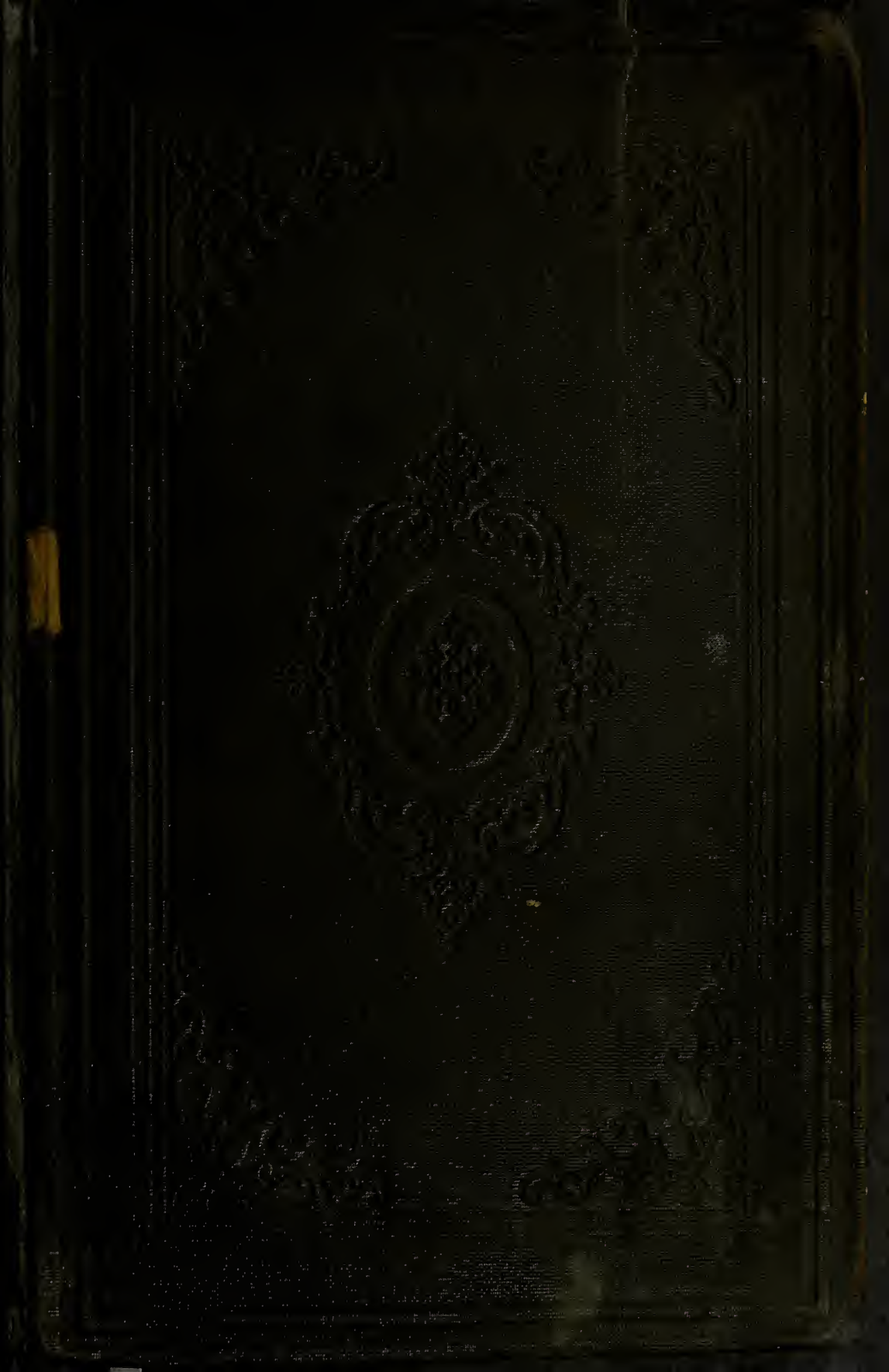
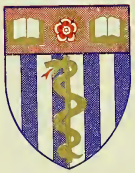


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LECTURES

ON THE

DIAGNOSIS AND TREATMENT

OF THE

PRINCIPAL FORMS

OF

PARALYSIS OF THE LOWER EXTREMITIES.

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ERRATA.

Page 7, line 6, instead of "Dr. W. Zull," *read* "Dr. W. W. Gull."

Page 15, line 8, instead of "Zebriskie," *read* "Zabriskie."

Page 116, line 11, instead of "*loco dotente*," read "*loco dolente*."

Pages 9, 23, 24, and 25. The references to a preceding lecture apply to another work of the author; his *Course of Lectures on the Physiology and Pathology of the Central Nervous System*.

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PARALYSIS

OF THE

LOWER EXTREMITIES.

LECTURE I.[1]

PROOFS OF THE EXISTENCE OF REFLEX PARAPLEGIA.

Proofs of the existence of a form of paraplegia produced by a reflex action, and mechanism of this production.—Frequency and rapidity of cure of this form of paraplegia, when its peripheric cause has been cured.—Importance of the diagnosis between the reflex and other forms of paraplegia, on account of the difference of treatment of these various forms of paralysis.—Danger of employing blindly certain active remedies without having ascertained what is the form of paraplegia to be treated.

GENTLEMEN: The principal object of these lectures is to point out the extreme importance of a clear diagnosis of the various forms of paralysis of the lower limbs, and especially of the two most frequent and distinct forms, viz: the *reflex paraplegia*, and the paralysis due to myelitis. The necessity of distinguishing this last form of paraplegia from the preceding, will become quite evi-

[1] The substance of these Lectures, in a condensed form, was part of a Course of Lectures on various subjects, delivered in April and May, 1859, to classes of Professors, Practitioners, and Medical Students in the Universities of Edinburgh and Glasgow, and in Dublin.

dent when we have shown that of the various active remedies that are most frequently employed against the paralysis of the lower limbs, especially strychnine, phosphorus, sulphur, mercury, ergot of rye, belladonna, and cantharides, some may prove beneficial in one form of paraplegia, and extremely injurious in the other form, while others of those medicines act just in the opposite way to the preceding.

Although a great deal has been done in the last century by R. Whytt, Pott, and others, with regard to the clinical history of paraplegia, it is in this century, and we might say during the last few years, that the most important practical features of this grave affection have been either discovered or well described. I do not intend to give here an account of the progress of our knowledge concerning this affection, as I only wish to discuss some practical questions; but in trying to solve these questions, I will take the opportunity of stating what we owe to the late Dr. Graves, of Dublin, to Romberg, and to several other writers.

The first questions I will examine relate to the so-called *reflex paraplegia*, *i. e.*, to a paralysis of the lower limbs, due to an excitation that has come to the spinal cord from a sensitive nerve. The excitation, after having reached this nervous centre, may be *reflected* on the bloodvessels of this very centre, or on those of the motor nerves or the muscles. I shall not stop to examine which of these three modes of production is the most frequent, as I am anxious to lay aside all the theoretical part of the history of paraplegia; but, before going

further, I must discuss the preliminary question whether there is really or not a *reflex paraplegia.* Looking at the large number of facts, recorded by various writers or observed by myself, it seems almost useless to enter into such a discussion, and I would not have done it, had not many able writers, especially Dr. W. Zull, Nasse, and Valentiner, lately tried to throw doubt on the existence of this form of paraplegia.

I will endeavor to show—

1st. *That a paralysis of the lower limbs may be caused by an alteration in the periphery or the trunk of the various sensitive nerves.*

2d. *That this kind of paralysis differs extremely from the other kinds of paraplegia by many symptoms, and by the frequency and rapidity of cure.*

The first of these two propositions can easily be proved by the very facts which serve to ground the second, and especially those facts in which a sudden or a very rapid cure followed the removal or cure of the alteration of a nerve, which was considered as the cause of the paralytic affection. It is evident that such a rapid cure could not take place in cases of paraplegia depending upon a disease of the spinal cord or its membranes. We will, by and by, relate several cases of rapid or immediate cure of paraplegia; and, amongst others, one recorded by Romberg, in which the paralysis which seemed to be due to a prolapsus uteri was very rapidly cured after the womb had been replaced in its normal position, and another mentioned by Graves, in which a paralysis of the lower limbs, due to a spasmodic

stricture of the urethra, was almost immediately cured by the dilatation of this canal.

The following characteristics of reflex paralysis, either in the lower limbs or elsewhere, tend to show how distinct this kind of affection is from cases of paralysis depending upon an evident organic alteration of the nervous centres:—

1. An outside excitation, starting from some sensitive nerve, exists before the reflex paralysis appears.

2. The variations in intensity of the outside excitation are often followed by corresponding variations in the degree of the reflex paralysis.

3. When the outside excitation ceases altogether, the reflex paralysis also sometimes ceases altogether, and in a short time.

4. The various modes of treatment of paralysis are usually unsuccessful in cases of reflex paralysis so long as the outside excitation persists.

5. Post-mortem examinations in cases of reflex paralysis show that this affection does not depend upon any marked organic alteration.

If there were not cases enough to show the existence of reflex paraplegia, the immense number of cases of reflex paralysis in all the upper parts of the body would already be sufficient to prove at least the possibility of the production of this affection in the lower limbs. We might easily give long lists of cases of paralysis, the production of which cannot be explained otherwise than by a reflex action. We will only mention a few, to show that almost all the parts of the body may be

affected with paralysis in consequence of an outside excitation.

1st. Paralysis of the optic nerve (amaurosis). There are many cases of this paralysis due to an injury to the frontal nerve, and there are several in which the cure has been very rapid after the section of the nerve between the irritated spot and the nervous centre, so as to abolish reflex action. (See my *Lecture at the College of Surgeons*, above, p. 157.)

2d. Paralysis of the auditory nerve has been observed as a consequence of a neuralgia, appearing, increasing, diminishing, or disappearing with this outside nervous excitation.

3d. Paralysis of one arm, one hand, of a few muscles of the face, the eye, the neck, the trunk, of the pharynx, the œsophagus, the bladder, the rectum, has been observed as a consequence of an excitation of a sensitive nerve of animal or organic life. Teething, worms, some kinds of irritation of the womb, and diphtheritis, are the most frequent causes of these partial paralyses, which have often been cured, almost at once, or very rapidly, after the cessation of the cause. (See, above, *Lecture* X. pp. 164–66.)

4th. The cases of intermittent paralysis of the arm, the face, or even the whole half of the body, as, for instance, a case recorded by Ollivier d'Angers,[1] are usually reflex affections, appearing and disappearing with an outside excitation.

[1] Traité des Maladies de la Moelle Epinière, Paris, 1837, vol. ii. p. 12.

5th. The paralysis of various parts of the body, depending upon a progressive muscular atrophy, is also, in many cases, of a reflex origin, the atrophy being due to a peripheric excitation, such as neuralgia, as shown by my pupil and friend, M. Clément Bonnefin, in a paper that will soon be published.[1]

That a paraplegia may be caused by external excitations as well as other kinds of paralysis, is a fact which will be, I hope, clearly established by the history I am about giving, of the symptoms and treatment of the various forms of paraplegia.

Before relating cases of reflex paraplegia with autopsy, I will mention a number of cases showing that this

[1] The number of cases of reflex paralysis, published in the medical journals, and in many works, is so considerable that it would be easy to give cases of paralysis or anæsthesia of the various parts of the body, showing that the outside exciting cause may start from any sensitive nerve, and especially from its termination in a mucous membrane or in the skin. We will only refer here to some few cases in which paralysis was caused by worms. Pétrequin mentions a case of *amaurosis, immediately* cured after the expulsion of a tænia. Other cases of rapid cure of amaurosis after the expulsion of worms, have been recorded by Houzelot, Remer, Fallot, Revolet, and Giraudy. (See Traité des Entozoaires et des Maladies Vermin, p. 57, par C. Davaine, 1859.) Itard relates two cases of rapid cure of *deafness* after the expulsion of lumbrici. Other cases are mentioned by Davaine. (Loc. cit., p. 57.) Mondière relates a case of *immediate* cure of *aphonia*, after the expulsion of sixty lumbrici. (Gaz. des H$pit., p. 208, 1843.) In the Journal l'Expérience (vol. vi. p. 47, 1840), there is a case of a woman, who, for three months, was *paralyzed of the two upper limbs*, and who was cured *immediately* after the expulsion of a tænia. This case had been observed by Dr. Moll, of Vienna. Mangon relates a case of *hemiplegia* cured a few days after the expulsion of worms. (Davaine, loc. cit., p. 56.) It would be very easy to lengthen considerably the list of such cases. I will refer those who wish to know more on this subject to the admirable work of my learned friend, Davaine; and to an excellent paper of Dr. Heslop, of Birmingham, published in the Dublin Quarterly Journal of Medical Science of May and August, 1859.

peculiar kind of paralysis really is due to an irritation springing from various sensitive nerves, and that its cure depends upon the cure of the disease which has caused this irritation.

1. *Cases of Paraplegia due to a Disease of the Uterus.*— In 1855, a young lady consulted me for what she called an extreme weakness, which was really a paraplegia, almost complete at each menstrual period. No diminution of any kind of sensibility; no paralysis of the bladder or the rectum; no symptom of hysteria. Dysmenorrhœa, anteflexion of the uterus, which was extremely sensitive, very large and congested, bearing-down pain, &c. In a few days after the use of a bandage to support the womb, a great amelioration was evident; and, in less than two weeks, the paralysis had entirely ceased. It had lasted six months, and had vainly been treated by strychnia, galvanism, shower baths, steel, and other tonics.

Lisfranc (*Clinique Chirurgicale de la Pitié*, vol. ii. p. 199, 1842) mentions the case of a lady, completely paralyzed of the lower limbs, who was vainly treated, by the most active remedies, for a supposed affection of the spinal cord, and who became better only when treated for a chronic metritis. The progress towards a complete cure, which was obtained after a long period, took place gradually, the change in the paraplegia following that of the inflammation of the womb. Lisfranc mentions another case in which also the gradual amelioration of the paraplegia corresponded with that of the disease of the uterus, and a complete cure was obtained.

An excellent observer, Dr. Nonat, has seen seven or eight cases of paraplegia, depending upon an affection of the womb, in which the paralysis was quickly cured after the cure of the disease of the uterus. Those cases show that when the uterine affection is limited to one side the paralysis is also limited to only one limb, and on the corresponding side. Those cases have been published by a pupil of Dr. Nonat, Mr. Esnault (*Des Paralysies Symptomatiques de la Métrite et du Phlegmon Utérin*, Paris, 1857).

Mr. Henry Hunt, of Dartmouth, Prof. Romberg, Dr. Wolf, of Bonn, and others have also mentioned cases of paraplegia, following a disease of the womb, and more or less quickly cured after the cure of this disease.

What is the mode of production of paraplegia in those cases? We cannot admit that paralysis was due to a pressure upon the nerves of the lower limbs—at least in most of those cases—as the enlargement of the organ was not sufficient to produce such an effect. Besides, in those cases sensibility was but slightly or not at all diminished, which excludes the idea that it was chiefly or only a pressure on the nerves of the lower limbs that caused the paralysis. We must, therefore, admit that it is either through a peculiar influence upon the spinal cord, or in consequence of some alteration in the blood, that paraplegia takes place in cases of disease of the womb. This last explanation, of which I would not have spoken if it had not been presented to me as the right one, we must reject, because there is no reason whatever why an alteration in the blood should rather

produce a paralysis of the lower limbs than of the other parts of the body. We must conclude, then, that it is through a peculiar agency upon the spinal cord that an affection of the womb produces a paraplegia. What this agency is we will try to show in another lecture.

2. *Cases of Paraplegia due to a Disease of the Urethra.* —Graves (*Clinical Lectures on the Practice of Medicine*, 2d edit., edited by J. M. Neligan, M. D., 1848, vol. i. p. 554) relates the case of a sailor who was treated by Dr. Hutton for a stricture of the urethra, due to gonorrhœa. There were chills, dysuria, and loss of power of the lower limbs. "A very remarkable amendment took place in his back and lower extremities in a few days after the first introduction of the instrument; in fact, it was almost sudden." The paraplegia was soon cured, together with the disease of the urinary canal. Several cases, more or less similar to this one, are related by Leroy d'Etiolles, Jr., and other writers.

3. *Cases of Paraplegia due to an Inflammation of the Bladder.*—In a patient whom I saw in one of the wards of the Charité Hospital at Paris, under the care of Rayer, and whose case is published at length by Leroy d'Etiolles, Jr. (*Des Paralysies des Membres Inférieurs, &c.*, Paris, 1856, pp. 57–59), the lower limbs became weak after an incontinence of urine, due to gonorrhœa. Cystitis appeared, soon followed by a notable but incomplete paraplegia. Gradually the paralysis diminished, while the inflammation of the bladder was subsiding, and a complete cure was obtained. Several other cases like

this one are recorded by Leroy d'Etiolles, Macario, and others.

4. *Cases of Paraplegia due to a Disease of the Prostate.*—A patient consulted Rayer, Magendie, and Leroy d'Etiolles, Sen., for an enlargement of the prostate, which was followed by a paraplegia. The swelling proved to be due to an abscess, which opened, and continued for some time to give pus. When the suppuration stopped, the paraplegia began to diminish, and was quickly cured. (Leroy d'Etiolles, Jr., *loc. cit.*, p. 83.) Other cases, nearly similar to this one, have been observed by Civiale and others.

5. *Cases of Paraplegia due to a Nephritis.*—Rayer has published several cases of this kind of paraplegia in his classical work on Diseases of the Kidney (*Traité des Maladies des Reins*, vol. iii.). In one case, weakness appeared in the lower limbs of a patient some time after he was attacked with nephritis. An amelioration soon took place in the nephritis and in the paralysis, under a treatment directed against the former. The patient left the hospital; but a short time after he was suddenly attacked again with acute symptoms of nephritis, and lost the power of standing on his feet. Cupping and diuretics quickly cured the inflammation of the kidney, and in less than a fortnight he was also cured of the paraplegia. It must be remarked how quickly in this case the symptoms of paraplegia appeared and disappeared twice after the operation, and the cessation of a nephritis.

6. *Cases of Paraplegia due to Enteritis.*—Two cases are recorded by Graves (*loc. cit.*, vol. i. pp. 547–9), in which the lower limbs were paralyzed after an attack of inflammation of the bowels. There was no numbness, no pain, no formication. In one only of these cases the bladder and rectum were a little paralyzed. In both patients there was a marked loss of the muscular sense. They both recovered. Zebriskie mentions a case of cure of paraplegia in three weeks, after the cure of an inflammation of the colon, which seemed to have caused the paralysis. (*Gaz. Méd. de Paris*, 1842, p. 296.) Several cases of paraplegia, apparently due to dysentery, and cured after the cure of this affection, are also on record. (Macario, *Gaz. Méd.*, 1858, p. 161).

To the cases of inflammation of the bowels we may add those of irritation of these organs by worms. Such cases of paraplegia cured immediately, or in a short time, are indeed far from being rare. We will only say that instances of this kind have been observed by Bremser, by Mœnnich (*Biblioth. Méd.*, vol. lxi. p. 269), and by Dr. Calvert Holland (*Edin. Méd. and Surg. Journal*, 1845, vol. lxiii. p. 325).

7. *Cases of Paraplegia due to an Affection of the Lungs or the Pleuræ.*—Three cases of this kind are recorded by Macario (*L'Union Méd.*, 1859, p. 276). I have seen a similar case (in 1849) at the Charité Hospital, in Paris. The patient I saw was cured in a few weeks. Two of those seen by Macario were cured, and one died.

8. *Cases of Paraplegia due to Diphtheria.*—Maingault (*De la Paralysie Diphtérique*, Paris, 1860, p. 45) relates the case of a young girl who, after an attack of diphtheria, became completely paraplegic. For a fortnight no change, but from that time gradual recovery; complete cure in three months. Trousseau has seen a similar fact in a child nine years old; and Sellerier has seen paraplegia, following diphtheria, cured in a month, in a gentleman forty years old. (Maingault, *loc. cit.*, p. 46.) I will try to show, hereafter, that paralysis due to diphtheria ought to be considered in the same light as the cases of paralysis more evidently of a reflex origin.

9. *Cases of Paraplegia due to Teething.*—I have seen a very interesting case of this kind in which the paraplegia, which had appeared at the very beginning of the second dentition, in a boy five years old, increased and decreased alternately at the time of, and after, the cutting of each of three molars. In that case there was a slight contraction in some of the paralyzed muscles. Simple hygienic means, shampooing, galvanism, and a decoction of cinchona bark were employed with success. The child was cured two months after the cutting of all his teeth (except the so-called "wisdom teeth"). Underwood has seen a case of paraplegia appearing after every cutting of a tooth. Fliess and others have already shown the relation between teething and paraplegia, and it would not be difficult to prove that those very able writers (especially Dr. Kennedy and Dr. West), who think that it is chiefly the condition of the bowels in teething that causes paralysis, have been misled by the

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fact that very frequently enteritis precedes paralysis. Usually, enteritis in teething, as well shown by Dr. Cain and Dr. Fraser Campbell, is produced by a reflex action, and paralysis seems to be generated in the same way, but paralysis may then be sometimes the result of a reflex influence of enteritis.

10. *Cases of Paraplegia from Irritation of Nerves of the Skin.*—Amongst these cases are the very numerous ones due to cold and wet. Graves (*loc. cit.*, p. 563), relates the case of a gentleman, fond of shooting, who became paraplegic after having exposed his lower extremities to wet. There was no pain in the back; no tenderness on pressure. He was but incompletely cured. This is the kind of reflex paraplegia which usually is most difficult to cure. However, it may be completely and very rapidly cured, as shown by two cases, one mentioned by Dr. T. Watson in his classical work, *On the Principles and Practice of Physic*, in which case the cure was obtained in a few days, and the other by Dr. W. Moore, of Dublin (*The Lancet*, vol. ii. 1859, p. 282), in which case the patient, who owed his paraplegia to a long exposure to a heavy rain, was cured after six or seven days of treatment.

Graves (*loc. cit.*, p. 557) gives a case of hemi-paraplegia due to the irritation of cutaneous nerves by erysipelas, occupying the calf and inside of the right leg. The erysipelas yielded to treatment, but for several days the patient was altogether destitute of any power of motion in the affected limb. It is evident (says Graves) that this must have been a reflex paralysis, as the mus-

cles which move the leg on the thigh lay far above the part in which the erysipelatous inflammation existed.

11. *Case of Paraplegia arising from Disease of the Knee-Joint.*—I have had under my care an American gentleman, who, according to all appearances, became paralyzed of the two lower limbs in consequence of the irritation starting from an acute inflammation of the synovial membrane of the left knee-joint. The paralysis at first was limited to the left limb, but soon appeared in the other. The arthritis became chronic, and then it was observed, a great many times, that every increase in the pain, due to this inflammation, was followed by a corresponding increase of the paraplegia, and that the reverse occurred, as regards the paraplegia, when the pain diminished or ceased. There was no special symptom of any affection of the spine or its contents—except, of course, the paralysis, and a notable degree of muscular atrophy. The patient, after five months of treatment, was very much improved, and could walk pretty well, except at times, when there was a return of the pain in the knee.

12. *Cases of Paraplegia due to a Neuralgia.*—Two years ago I saw a case of this kind in consultation with Dr. Gordon, of Boston, U. S. However, as this is not a case of rapid cure, I will not speak of it now. Several cases of paraplegia, with or without atrophy of the paralyzed muscles, are mentioned by Notta (*Archives de Méd.*, Nov. 1854, p. 556). All the patients have been cured of the paralysis some time after the cure of the neuralgia.

The above cases, and many others which we could mention, show that the production of paraplegia may be associated with irritations starting from very different parts—such as most of the viscera, the skin, the mucous membranes, and the trunks of nerves. In all these cases we find that paraplegia has followed the outside irritation, which we consider as its cause, and that the cure of this paralysis has been more or less quickly obtained after the supposed outside cause had been suppressed. Besides, in many of these cases we find the supposed effect increasing or decreasing gradually, in correspondence with the outside irritation, and in several instances we find that even without treatment the paralysis disappeared after the cessation of its supposed cause; while, as a general rule, no treatment of the paraplegia seemed to have the least influence so long as the outside irritation was not alleviated, or had not entirely ceased. In some cases we find that paraplegia appears and disappears altogether, twice, or many more times, in correspondence with the renewed production and cessation of the outside irritation. Can there be more decisive proofs that it is the outside irritation starting from some sensitive nerves in various parts of the body which produces the paraplegia?

Those persons who, perhaps, are not struck by the evidence in the foregoing facts and reasonings may argue against the view that paraplegia is the effect of an outside irritation in the cases we have mentioned: 1st, that there is no need of admitting such a view, as other explanations of the various cases can be given;

2dly, that it is not possible to explain by a reflex action the production of a paralysis.

The first of these objections may in appearance be well grounded, as it may be said—

1. That, in cases of disease of the uterus, this organ produces paralysis by pressing upon the obturator nerve and the sacral plexus.

2. That, in cases of disease of the prostate, the urethra, or the bladder, the urine, not being freely expelled, becomes altered, and some of the altered principles are absorbed and act as poisons, producing paralysis.

3. That, in cases of disease of the kidney, paraplegia is due to uræmic poisoning.

4. That, in cases of teething, of diphtheria, and of disease of the bowels, the lungs, or the pleuræ, paraplegia is due to an alteration in the blood, caused by the disturbance of digestion or respiration.

5. That, in cases of paraplegia due to the action of cold and wet, we ought to place this affection in the category of rheumatismal paralyses.

6. That, in cases of pain in the skin, in joints, or in trunks of nerves, paraplegia has no other relation to this pain than that of being produced together with it by some affection of the spinal cord.

I am ready to admit that in some cases paraplegia is produced in the various ways just related; but in most of the cases in which a paralysis of the lower limbs follows an outside irritation from the womb, the bladder, or most of the other organs, when there is no evidence of an organic affection of the spinal cord or of the sur-

rounding parts, it is not possible to explain the production of the paralysis by a pressure on nerves, an alteration of blood, &c. This I must show, as, lately, Romberg,[1] one of the promoters of the view that paraplegia may be caused by a reflex action, has acknowledged that he was ready to abandon it on account of objections advanced by Hasse and Valentiner.

1. As regards paraplegia depending upon disease of the womb, we will remark that, except in cases of very great enlargement, as sometimes in pregnancy, pressure upon the nerves of the lower limbs cannot be the cause of the paralysis. In the case I have mentioned, of a young lady who was cured by using a bandage, the uterus was certainly not larger than in a woman at the end of the second month of pregnancy.

2. It is possible that in cases where urine accumulates in the bladder, and remains there a long while in an altered condition, some of its principles may be absorbed and act as a poison; but, on the one hand, however possible this is, there is no proof that a paralysis has ever been produced in that way; and, on the other hand, we find that it is with the degree of pain that paraplegia has relations in cases of paralysis of the lower limbs following an affection of the prostate, the urethra, or the bladder, and not with the retention of urine, as there is no change in this kind of paraplegia, whether the bladder is carefully voided or not, at every time there is a certain amount of urine in it, unless the irritation start-

[1] Lehrbuch der Nervenkrankheiten des Menschen. Dritte Abth. 3d ed. 1857, p. 913.

ing from either the bladder itself, or the prostate, or the urethra, be diminished.

3. Certainly, in cases of nephritis, there may be paralysis due to uræmic poisoning; but this kind of poisoning does not manifest itself only by a paralysis. On the contrary, it causes other and most striking symptoms, none of which has existed in the case I have cited, and in other more or less similar cases.

4. I am willing to admit that there is some alteration in the blood in diphtheria, or even in dysentery, in enteritis, &c. I am also willing to admit that this alteration may cause a degree of paralysis; but that a complete paraplegia, without any diminution of voluntary movement elsewhere, may be due to a cause which, as it is supposed to be in the blood, is *circulating everywhere in the body*, I think no one can admit.

5. It is true that cold and wet often cause rheumatism; but when, after an exposure to cold and wet, a man is suddenly seized with paralysis, without having the least symptom of rheumatism, we certainly have no right to place his affection in the vague group of rheumatismal paralyses.

6. No doubt that diseases of the spinal cord and its membranes very often manifest themselves by pains resembling neuralgic pains, and located either in a joint or along the course of a nerve; but, besides the fact that, in such cases, paraplegia, when it appears, is accompanied by symptoms indicating a disease in the spinal cord or its membranes, which was not what occurred in the cases I have mentioned, there were real

inflammations (of a joint, or of the skin) in two of those cases, instead of the *referred* pain due to a centric cause.

We think we may safely conclude, from this examination of the above explanations, that they can be considered as valuable only for a small number of those cases in which paraplegia has appeared after an irritation in some sensitive nerve of the skin, the mucous membranes, and various organs. On the one hand, therefore, most of those cases cannot receive these explanations; and, on the other hand, I have already shown that the period of apparition, the varieties of intensity, the progress, and the cure of paraplegia, in the cases I have mentioned, are in perfect correspondence with the view that paralysis depended upon an irritation from a sensitive nerve.

I have now to examine the objection that it is impossible to understand how a paraplegia can be caused by a reflex action. It is, indeed, very easy to show how a paralysis can take place by a reflex influence through an irritation starting from a sensitive nerve. There are two modes of reflex action by which such an irritation can produce paraplegia:—

1st. *Reflex Contraction of Bloodvessels.*—As it is now well established that bloodvessels contract with energy, and sometimes even are seized with a real and prolonged spasm, whether by a direct influence of their motor nerves, or through an excitation, which, from some centripetal or excito-motor nerve, has been reflected upon them by the cerebro-spinal axis (see the preceding

Course of Lectures, pp. 139 to 180, *Lects.* IX., X., and XI.), there is no need of showing here that bloodvessels are just like muscles of animal life as regards their relations with the nervous system. This being the case, it is extremely easy to understand how a paralysis of the lower extremities, as well as that of any other part of the body, may be paralyzed by a reflex action. In three different places a contraction of bloodvessels may cause paraplegia—1, in the spinal cord; 2, in the motor nerves; 3, in muscles. A contraction of bloodvessels in the spinal cord *I have seen* (in the vessels of the pia mater) taking place under my eyes, when a tightened ligature was applied on the hilus of the kidney, irritating the renal nerves, or when a similar operation was performed on the bloodvessels and nerves of the suprarenal capsules. Generally in those cases the contraction is much more evident on the side of the cord corresponding with the side of the irritated nerves, which fact is in harmony with another and not rare one, observed first by Comhaire (as regards the kidney), and often seen by me after the extirpation of one kidney or one suprarenal capsule—*i. e.*, a paralysis of the corresponding lower limb. It is probable that irritations starting from the urinary and other organs produce a paraplegia by a contraction rather of the bloodvessels of the spinal cord than of those of the motor nerves and muscles. However, in this form of paraplegia, it is not rare that a notable diminution of temperature of the paralyzed limbs shows that the bloodvessels of these parts are also contracted.

2d. *Morbid Reflex Influence on Nutrition.*—This influence, proved by many experiments on animals and by pathological facts of daily occurrence (see the preceding *Lectures*, pp. 146–50), seems usually not to exist in reflex paraplegia, except in that form in which muscles become progressively and rapidly atrophied and altered (*wasting palsy*). But this morbid influence may take place at any moment in the course of a reflex paraplegia, so long as the irritating cause has not ceased to act, and a myelitis or some other affection may be generated by it.

We think that it will now be considered possible, if not probable, that the production of reflex paraplegia is due to a contraction of bloodvessels and to the insufficiency of nutrition that follows this condition of the vessels. In addition to the reasons we have given to show that the paraplegia caused by an outside irritation is due to a reflex action and probably to a reflex contraction of bloodvessels, we will say that very often in this peculiar kind of paralysis there are reflex convulsions in muscles of the trunk, the head, or the limbs, before the paraplegia appears (as in cases of teething, of worms, &c.), or when it has already existed some time (as on the passage of a catheter, in urinary paraplegia). We might also have pointed out the influence of the urethra on the spinal cord, by mentioning the well-known and very frequent fact of the production of chills and tremor on or after the introduction of a catheter in persons who are or who are not paraplegic.

There is another series of facts of which we have now

to speak, that show that reflex paraplegia is not due to an evident organic affection, which may be found in a post-mortem examination. We will very briefly mention some cases of autopsy made on persons who have died after having presented the symptoms of a reflex paraplegia.

We are indebted to Mr. E. Stanley[1] for the first paper of importance on urinary paraplegia. In this classical paper the following cases are recorded: 1. Paraplegia combined with retention of urine. *Autopsy:* No visible alteration of the cerebro-spinal axis; one of the kidneys and the bladder inflamed. 2. Partial loss of power in the upper and lower limbs. *Autopsy:* No morbid appearance in the cerebro-spinal axis. 3. Severe gonorrhœa, complete paraplegia. *Autopsy:* No morbid appearance in the spinal cord; inflammation of both kidneys and bladder. 4. Nearly similar case with the preceding. 5 and 6. Mr. Hunt (in Mr. Stanley's paper) mentions two cases in which a blow on the back was followed by nephritis and paraplegia. No alteration of the nervous centres, except, in one of the cases, a congestion of the spinal sheath.

In his excellent collection of cases, Leroy d'Etiolles, Jr. (*loc. cit.*, pp. 23–35), gives the following: 7. Woman, under the care of M. Rayer; nephritis and paraplegia. *Autopsy:* The cerebro-spinal axis and its membranes perfectly healthy; bladder and kidneys inflamed. 8. The celebrated surgeon, Sanson, was attacked with an

[1] Medico-Chirurgical Transactions, vol. xviii. 1833, p. 260.

enlargement of the prostate, stones in the bladder, and retention of urine, followed by paraplegia. *Autopsy*, made by Rayer, Cruveilhier, and Chomel: No alteration of the spinal cord. 9. Cystitis, nephritis, and paraplegia. *Autopsy*, made by Dr. Leudet, of Rouen, an excellent observer, and Leroy d'Etiolles, Jr.: No softening; no change of color of the spinal cord. 10. Retention of urine; cystitis; nephritis. *Autopsy:* Thorough examination of the spinal cord, which was found healthy.

It would be easy to enlarge this list of cases. I will only mention a few more: 11. Dr. Waddel (*American Journal of Medical Science*, Feb., 1835, p. 299) relates a case of paraplegia connected with a disease of the bowels. *Autopsy:* No alteration of the spinal cord; pus in the bowels; ulceration of the duodenum. 12. A man, observed by that eminent physican, Dr. Stokes, of Dublin, was often exposed to wet and cold; he became paraplegic. *Autopsy:* The cauda equina appeared to be slightly softened; but, from the appearance, Dr. Stokes could not state that it was actually diseased; the rest of the spinal cord appeared healthy and normal. (Graves, *Clinical Lectures*, vol. i. p. 563.) 13. Difficulty of micturition, preceding a paraplegia. *Autopsy:* Membranes of the cord healthy; no traces of inflammatory granules anywhere, either in the spinal cord or its membranes; hours were vainly spent in search of some alteration; cystitis. (Dr. W. W. Gull, *Guy's Hospital Reports*, vol. iv., 3d Series, Case xvii. p. 174.)

I know full well that, as no microscopical examination was made in any of the above cases, except the last, I

am not entitled to assert that it is really established by those cases that reflex paraplegia may exist without an evident alteration of the spinal cord. But, when we think of the number of cases in which that affection has been rapidly cured; when we remark that in most of the above cases the autopsy was conducted by men of great and much-deserved reputation as careful observers, and that in all those cases it was expected that some alteration would be found; when we remember that a myelitis very rarely indeed can exist without evident changes in the color, in the vascularity, and especially in the consistence of the spinal cord; and when we find also that the symptoms in most of those cases were not those of an organic affection of the spinal cord, we are almost necessarily led to conclude that those cases show that reflex paraplegia is not accompanied by an evident alteration of the spinal cord. This view will be strengthened in the next lecture, in which we will discuss the opinions of Dr. W. W. Gull on the urinary paraplegia.

Before concluding this lecture, I wish to say a few words on a most important point, to which we will again turn our attention in the succeeding lectures; I mean, the treatment of reflex paraplegia. I have already said that the various kinds of paraplegia may be classed into two general groups: one in which the amount of blood circulating in the spinal cord is too considerable; the other, in which the opposite condition exists. Of the various remedies, which, as I may perhaps be allowed to say, are too often blindly employed, there are some that

diminish the quantity of blood in the spinal cord, such as mercury, ergot of rye, and belladonna; while others, on the contrary, such as strychnine and brucine, increase that quantity.

If these last assertions be correct—and I will, by and by, try to prove that they are—it is quite evident that to employ a remedy of either of these two kinds in both of the two groups of paraplegic cases is a most dangerous thing. Reflex paraplegia, as pointed out by its whole history given in this lecture, is accompanied and most likely produced by an insufficiency of the amount of blood in the spinal cord; it ought not, therefore, to be treated by those remedies which diminish the quantity of this fluid in the spinal nervous centre. How often, however, is not mercury employed in that affection! On the other hand, myelitis, which is accompanied by an increase in the quantity of blood in the spinal cord, is often treated by the very remedy (strychnine) which has the most powerful influence in increasing the amount of blood in the spinal cord! How important, therefore, it is to know exactly to what special group (as to the quantity of blood in the spinal cord) belongs a paraplegia, before we give a remedy included in either of the two categories above-mentioned!

In the next lecture we will examine more at length the important questions connected with these observations.

LECTURE II.

DIAGNOSIS AND TREATMENT OF THE REFLEX PARAPLEGIA.

Answer to objections against the existence of the urinary reflex paraplegia.—Affections of the urinary apparatus may cause paralysis either by a simple reflex influence, or in producing myelitis.—Condition of muscles in reflex paraplegia.—Diagnosis between the reflex paraplegia and paralysis of the lower limbs due to myelitis, meningitis, pressure upon the spinal cord, a tumor in the gray matter, hysteria, seminal losses, hemorrhage in the spinal canal or in the spinal cord, congestion, serous effusion, non-inflammatory softening, obstacle in the circulation of blood in the aorta or other large arteries, pressure on nerves, etc.—Remarks on the pretended essential or idiopathic paraplegia.—Prognosis of the reflex paraplegia.—General principles of treatment of the reflex paraplegia.—Means of diminishing the external irritation that causes a reflex paraplegia.—Means of improving the nutrition of the spinal cord.—Means of preventing the ill effects of rest in the paralyzed nerves and muscles.

GENTLEMEN: There is an objection against the existence of the *reflex urinary paraplegia*, of which I must speak, as it has been put forward by a most able physician, Dr. W. W. Gull.[1] This distinguished observer has found the spinal cord apparently healthy, when examined with the naked eye, while the microscope proved that it was inflamed, in a case of paraplegia succeeding to a gonorrhœa; and he relates other cases of paraplegia due to myelitis, and preceded by a disease of the urinary apparatus. He is inclined to think that in the cases of urinary paraplegia published by Mr. Stanley, there was

[1] Medico-Chirurg. Transactions, 1856, vol. xxxix. pp. 195–204.

a myelitis that would have been detected had the microscope been employed.

It is very remarkable that Dr. Gull himself has published a case, more able than any other I know, to prove that there is no alteration of the spinal cord or its membranes in the reflex urinary paraplegia. The symptoms in this case were those of this kind of paralysis, and not those of myelitis. "Hours were spent," says Dr. Gull, "in the examination of the cord, but with no other result than to show that there was no appreciable lesion of it besides a slight and doubtful softness of the tissue in two points."[1] Here the microscope was used by a man who knows full well how to employ it, and who was anxious to find some lesion to confirm his diagnosis, and this investigation gave a negative result. Certainly every one will conclude with this most accurate observer "that the spinal cord may have its functions impaired and even lost, and that suddenly, as far as the power of motion is concerned, without any distinct amount of anatomical lesion." (*Loco cit.*, p. 175.)

The facts brought forward by Dr. Gull against the views of Mr. Stanley are not at all in opposition to these views. They show that myelitis may be caused by an irritation originating from the urinary apparatus, but they do not show that such an irritation must produce a myelitis, in order to induce a paraplegia; or, in other words, that there is no other mode of production of a paraplegia by such an irritation than through a myelitis.

[1] Guy's Hospital Reports, Third Series, vol. iv., Case 17, p. 174.

The cases recorded by Dr. Gull, and those of which we have given a summary in the preceding lecture, clearly prove:—

1st. That when the symptoms of a myelitis have existed in a case of paraplegia, the autopsy may show no visible alteration of the spinal cord or its membranes, except when the microscope is employed. (It is probable that in one or two of the cases in Mr. Stanley's paper the alterations of myelitis would have been found had the microscope been used.)

2d. That when the symptoms of a reflex paraplegia have existed, as in the above case of Dr. Gull, no distinct anatomical lesion is found in the spinal cord, even when the microscope is employed.

3d. That urinary paraplegia may be simply a reflex paralysis or be connected with myelitis in three ways—*a*, the myelitis producing at the same time some alteration in the kidneys or the bladder and the paraplegia; *b*, the urinary affection acting upon the spinal cord by a nervous influence, to produce myelitis and consequently the paraplegia; *c*, the inflammation of a vein of the urinary organs being propagated to a vein of the spinal cord, and a myelitis and a paraplegia being the consequence of this propagation (as in a case of Dr. Gull).

I shall not say more about the objection raised by the learned physician of Guy's Hospital, as it will be easy for any one to find out arguments against this objection in the preceding lecture, and also in the remarks I have now to offer to complete the history of reflex paraplegia. Striking differences exist between the symptoms of re-

flex paraplegia, and those of the various forms of paraplegia of centric origin, as will be seen by the following table, in which are condensed the principal features of two of the most characterized varieties of reflex and centric paralysis of the lower limbs, *i. e.*, the paraplegia due to a reflex influence from the urinary organs, and the paraplegia due to myelitis.

Urinary Paraplegia.	*Paraplegia from Myelitis.*
1. *Preceded* by an affection of the bladder, the kidneys, or the prostate.	1. Usually no disease of the urinary organs except as a *consequence of the paralysis.*
2. Usually lower limbs alone paralyzed.	2. Usually other parts paralyzed besides the lower limbs.
3. No gradual extension of the paralysis upwards.	3. Most frequently a gradual extension of the paralysis upwards.
4. Usually paralysis incomplete.	4. Very frequently paralysis complete.
5. Some muscles more paralyzed than others.	5. The degree of paralysis is the same in the various muscles of the lower limbs.
6. Reflex power neither much increased nor completely lost.	6. Reflex power often lost, or sometimes much increased.
7. Bladder and rectum rarely paralyzed, or at least only slightly paralyzed.	7. Bladder and rectum usually paralyzed, completely or nearly so.
8. Spasms in paralyzed muscles extremely rare.	8. Always spasms or, at least, twitchings.
9. Very rarely pains in the spine, either spontaneously, or caused by pressure, percussion, warm water, ice, &c.	9. Always some degree of pain existing spontaneously, or caused by external excitations.
10. No feeling of pain or constriction round the abdomen or the chest.	10. Usually a feeling as if a cord were tied tightly round the body at the upper limit of the paralysis.
11. No formication, no pricking, no disagreeable sensation of cold or heat.	11. Always formications, or pricking, or both, and very often, sensations of heat or cold.
12. Anæsthesia rare.	12. Anæsthesia very frequent, and always, at least, numbness.

Urinary Paraplegia.	*Paraplegia from Myelitis.*
13. Usually obstinate gastric derangement.	13. Gastric digestion good, unless the myelitis has extended high up in the cord.
14. Great changes in the degree of the paralysis corresponding to changes in the disease of the urinary organs.	14. Ameliorations very rare, and not following changes in the condition of the urinary organs.
15. Cure frequently and rapidly obtained, or taking place spontaneously after a notable amelioration or the cure of the urinary affection.	15. Frequently a slow and gradual progress towards a fatal issue; very rarely a complete cure.

The above table, as regards the reflex paraplegia, is drawn from very numerous cases observed by Mr. Stanley, Rayer, Leroy d'Etiolles, Jr., Landry, Macario, Mr. Spencer Wells, and others, or by myself. I have already given a short account of many of these cases.

This comparison of symptoms of a *reflex* with a *centric* paraplegia shows how important it is to find out if a disease of the urinary, or of other organs, has preceded the paralysis. But it must be remembered that a myelitis may be due and, therefore, succeed to a disease of the urinary apparatus. Besides, it is sometimes difficult to find out clearly the relation between an outside irritation and the paraplegia. In the case of a patient of Dr. Spencer Thomson, of Burton-on-Trent, who consulted me some time ago, an affection of the prostate had existed, and had been cured, when one day the patient, having been subjected to great fatigue, was attacked with a pain in the lower part of the spine; his urine became alkaline, and he was seized with paraplegia. Very quickly the urine reacquired its normal

reaction, but the paraplegia persisted. In this case, certainly, it would have seemed wrong to call the paralysis a urinary paraplegia, had not the symptoms and the ultimate history of the patient shown that it was really that kind of paralysis. The return of voluntary movements took place before the treatment (by mercury) had had time to act.

Usually in reflex paraplegia muscles do not become atrophied, and they remain almost as irritable as in healthy persons. Exceptions to this rule, however, are not very rare. I have seen two cases of reflex paraplegia—one due to an inflammation of the knee-joint, and the other to a sciatica—with considerable atrophy of the muscles of the legs, and of some muscles of the thighs. In one of these cases, the normal size and irritability of muscles were quickly restored by an appropriate use of galvanism. The study of the condition of muscles in cases of reflex paraplegia, as well as in other cases of paralysis, shows, as I have tried to prove elsewhere, that a rapid atrophy and a rapid loss of irritability are not caused by the *cessation of action* of the nervous system, but by *a morbid action* of this system upon the nutrition of muscles.[1]

It is usually easy to detect a reflex paraplegia from the other kinds of paralysis of the lower limbs. A rapid review of the various kinds of paraplegia will show upon what principles this diagnosis is to be grounded.

1st. *Myelitis.*—I have already given the differential

[1] See Journal de la Physiol. de l'Homme, &c., vol. ii., 1859, pp. 112–14.

characteristics between paraplegia due to myelitis and the reflex urinary paraplegia. I will only add now, that the urine, in cases of myelitis, is almost always alkaline; while in cases of reflex paraplegia, not depending upon a disease of the urinary organs, it is usually acid, as in healthy people. We may add, that a paraplegia following an irritation in some peripheric part of the body, increasing, decreasing, or disappearing with that irritation, presenting the peculiar symptoms we have already mentioned, rendered worse by modes of treatment that are useful in myelitis, and being cured or alleviated by modes of treatment that are unsuccessful, if not hurtful, in myelitis, certainly cannot, and must not be confounded with the paraplegia due to this inflammation.

2d. *Meningitis.*—Paraplegia depending upon the inflammation of the membranes of the spinal cord will be chiefly distinguished from the reflex paraplegia by a rigid spasm of the muscles of the back, by an intense pain caused by any motion of the lower limbs or of the spine, or by the spontaneous acute pains that radiate from the spine to the lower extremities, and the frequency of cramps, &c.

3d. *Pressure upon the Spinal Cord, by a Tumor, a Diseased Bone, or Fibro-cartilage, &c.*—We will show, by and by, that the symptoms of a pressure upon the spinal cord are not those which are generally described in treatises on the diseases of the nervous system. We will now only say, that a meningitis or a myelitis is often produced by tumors, diseased bones or intervertebral cartilages, and that the symptoms of both these inflammations have been

mistaken for symptoms of pressure upon the spinal cord. However, as regards diagnosis, when there is a pressure upon this nervous centre, there is usually a feeling of tightness, a pseudo-neuralgic pain, or a degree of formication, only in the parts of the body receiving their nerves, from the portion of cord which is pressed upon, unless there is a myelitis or a meningitis, in which case those symptoms may exist in all the parts of the body below the seat of the pressure. Usually there is pain or tenderness in the spine at the place where the cause of the paralysis exists. Those symptoms show how different this kind of paraplegia is from a reflex paraplegia.

4th. *Tumor in the Gray Matter of the Spinal Cord.*—A remarkable feature of paraplegia due to this cause is, that anæsthesia appears at the very beginning of the affection, and may reach a higher degree than that of the loss of the power of motion. It is not so in cases of reflex paraplegia. Another feature of paralysis due to a tumor in the centre of the spinal cord is, that the reflex power in the parts of the cord below the tumor becomes extremely exalted, so that very slight excitations can produce the most violent reflex movements.

5th. *Hysterical Paraplegia.*—Here the only great differential characteristic is, that the paraplegia has followed hysteria. But the difficulties sometimes are very great, as the same cause (such as a disease of the ovaries or the womb) may produce both hysteria and a reflex paraplegia. There is no harm, however, in not coming to a decided diagnosis as regards these two forms of

paraplegia, as the treatment ought to consist chiefly of the same means in both cases. We may add, that it is probable that in most cases, if not in all, hysterical paralysis is but a reflex paralysis.

6th. *Paraplegia Depending upon Seminal Losses.*—A microscopical examination, showing or not the presence of spermatoza in the urine or the prostatic mucus, will decide the question of the seminal losses; but the symptoms of paraplegia are usually alike in cases of loss of semen as in cases of simple urinary paraplegia, and it is probable that the production of paralysis is identical when sperma is lost, or when it is not, in cases of disease of the genito-urinary organs.

7th. *Hemorrhage in the Spinal Canal.*—Paraplegia due to this cause differs from the reflex paraplegia by the existence of a vague pain along the spine some time before the paralysis appears, by the suddenness of its appearance, and by the very frequent occurrence of violent convulsions, or, at least, of spasmodic twitchings.

8th. *Hemorrhage in the Gray Matter of the Spinal Cord.*—Paraplegia due to this cause appears suddenly, and is always accompanied by a notable diminution of sensibility, while in reflex paraplegia these two characteristics are rare. On the other hand, in this last kind of paralysis, the loss of movement is preceded by an affection of some viscus, of the skin, of the mucous membranes, &c.

9th. *Congestion of the Spinal Cord and its Membranes.*—This cause of paraplegia, so well studied by Ollivier d'Angers, differs by many of its symptoms from the

reflex paraplegia, but especially by the fact, that on rising after a night's rest, patients attacked with congestion in the spinal cord are much more paralyzed than when they have been moving about, or have stayed in a sitting posture for some time; while usually the reverse is observed in reflex paraplegia. Besides, several of the symptoms of myelitis, though to a less degree, exist in cases of congestion of the cord or its membranes, and not in the reflex paraplegia.

10th. *Serous Effusion in the Spinal Canal.*—The suddenness of the paralysis, pain in many parts of the spine, and, very frequently, convulsions, will serve to distinguish a paraplegia due to this cause from a reflex paraplegia.

11th. *Non-inflammatory Softening of the Spinal Cord.*—This affection, which is due either to the blocking up of bloodvessels by clots, or to a notable diminution of their calibre, or to the diminution or impossibility of nutrition of the medullary matter, owing to a calcareous deposit or to fatty degeneration of the vessels, may sometimes be very difficult to distinguish from a reflex paraplegia. However, the first of these affections will usually be recognized by the absence of an external cause of irritation on the spinal cord, by the very slow development of the paralysis, and sometimes by the arcus senilis, and the presence of a calcareous deposit in superficial bloodvessels of the head or the limbs, &c.

12th. *Paraplegia due to an Obstacle in the Circulation of Blood in the Aorta, or in its Principal Ramifications in the Pelvis.*—This kind of paralysis is frequent in

horses, and has been well studied by veterinary surgeons. Several cases have been observed in man by Mr. Barth,[1] Dr. W. W. Gull, and my friend Dr. Charcot.[2] Besides the symptoms due to the cause preventing the circulation (generally an aneurism), this kind of paraplegia will be distinguished from the reflex paraplegia by the absence of the causes of this last form of paralysis, by the alterations of nutrition and pains in the paralyzed limbs, and especially by the rapid increase of the paralysis after every notable exertion of the lower limbs, and the return of some power after rest.[3]

13th. *Paraplegia due to Pressure on Nerves in the Pelvis.*—During pregnancy, or in cases of a tumor in the pelvis, a complete paraplegia may be caused by pressure upon the nerves of the sacral and lumbar plexuses. Very frequently the pressure produces only a slight degree of paralysis. In most cases of paraplegia due to that cause, there is also another cause in action, *i. e.*, a pressure upon the bloodvessels. This kind of paralysis of the lower limbs will easily be distinguished from the reflex paraplegia by the existence of violent pains in the

[1] Archives de Médecine, 1835, vol. viii., 2e série, p. 26.

[2] Mémoires de la Société de Biologie pour 1858, vol. v., 2e série, p. 225.

[3] See a very curious case of that kind, published by Abercrombie (Pathological and Practical Researches on Diseases of the Brain, &c.; Fourth Edition; Edinburgh, 1845, pp. 281–83), in which a spontaneous coagulation of blood occurred in most of the large arteries in the body, so that no pulsation could be felt anywhere, except in the carotid arteries. It is very remarkable that in this case, as in the other cases of stoppage of circulation in main arteries that we know, there was not a complete paralysis. The general capillary circulation seemed to be sufficient to maintain a certain degree of motor and nervous power in muscles and nerves.

pelvis and in many parts of the lower limbs, by the production of cramps, &c.

The so-called *idiopathic paraplegia* is not to be taken into account in this history of the differential diagnosis of the reflex and other forms of paraplegia. We do not know any case of paralysis of the lower limbs that deserves the name of idiopathic. Most of the pretended cases of that kind, published by Macario and by R. Leroy d'Etiolles, are either cases of reflex paraplegia or of a real affection of the spinal cord (especially congestion and serous effusion). We do not mean to say that it will always be easy to decide during the life of a patient, or after a post-mortem examination, what is the cause of a paralysis of the lower limbs. We think that sometimes this cause will not be found out, and we only mean to state that it is impossible to admit the existence of a special kind of paralytic affection, deserving to be called *essential* or *idiopathic* paraplegia—an affection not more characterized by special symptoms than by special anatomical lesions.

Of other forms of paraplegia, such as those which are connected with gout, rheumatism, or those which follow grave fevers, cholera, &c., we will only say that usually they depend upon a serous effusion in the spinal canal or a venous congestion, and that sometimes they belong to the group of reflex paralyses. Therefore, we have not to say how to distinguish these forms of paraplegia from the reflex paralysis of the lower limbs.

Besides the various kinds of paraplegia of which we have spoken, there are many others of which we will

say nothing more at present than to state, that on account of their known causes, it is usually very easy to distinguish them from the reflex paraplegia. Amongst these kinds of paraplegia, I will point out especially those resulting from poisoning by carbonic acid, lead, arsenic, mercury, opium, belladonna, tobacco, camphor, mushrooms, fish; and those resulting from loss of blood, from concussion, fracture, or luxation of the spine.

In concluding our remarks on the diagnosis of the reflex paraplegia we need hardly say, that for this affection, as well as for all other diseases of the nervous system, it is not necessary to find together all the characteristic symptoms to be convinced of the existence of this morbid condition. A reflex paraplegia is almost sufficiently characterized by *the absence of the special symptoms of an organic disease of the spine or its contents, and the existence of an incomplete paralysis of the lower limbs that has appeared somewhat slowly after a disease of the urinary or genital organs, or of some other abdominal viscus; after an inflammation of the lungs or pleuræ, or after some kind of irritation of a nerve in its trunk or cutaneous ramifications.* In a great many cases of reflex paraplegia we shall find nothing else upon which to ground our diagnosis. But usually, in a short time a much greater probability of the accuracy of the diagnosis will spring from the correspondence between changes in the degree of the paralysis with changes in the visceral disease or external irritation that is supposed to have produced the paraplegia.

The prognosis of the reflex paraplegia depends, in a

great measure, upon that of the external affection which has produced it. The whole history of the reflex paraplegia shows that it usually increases, diminishes, or disappears with the external morbid condition which has produced it. As a general rule, so long as this morbid condition lasts, the paraplegia persists, and it ceases very quickly, and sometimes without any special treatment, after the cure of this morbid condition. In some cases, however, paraplegia persists long after its external cause has been completely cured. It is so especially when the paralysis has been produced by cold, or by a disease of the bowels. The reverse is more particularly observed after the evacuation of worms, or after a cure of a stricture of the urethra, or of an affection of the womb.

Of the two forms of reflex paraplegia, one of which depends upon an insufficiency of nutrition in the spinal cord, the other upon an alteration of nutrition in the muscles of the lower limbs—the first is almost always curable when the external irritation which has caused it has ceased; while the second is very frequently incurable, whether its external cause has ceased or not. It is, therefore, most important for the prognosis to ascertain if there has been or not, a rapid atrophy of muscles in cases of reflex paraplegia.

Treatment of the Reflex Paraplegia.—It is evident from all that we have said concerning the reflex paraplegia that, for this affection more than for any other, we must employ every effort to cure or alleviate the disease or irritation that has produced it. At the same

time the paraplegia itself must not be neglected, and the proper means must be employed against it. Therefore the treatment of a reflex paraplegia ought to consist of two distinct parts: 1st, the means to be employed against the external cause of this affection; 2d, the treatment of the paralysis itself. As regards the first part, we will say nothing here, as we cannot enter into the details of the treatment of nephritis, cystitis, pneumonia, enteritis, and other morbid states that may cause a reflex paraplegia. As regards the direct treatment of this affection, we will first lay down the general rules of the treatment, and then we will enter into the most important therapeutic details.

1. When it has been ascertained from what organ or from what nerve starts the nervous influence which causes a reflex paraplegia, besides the treatment that is appropriated to the nature of the local affection (of that organ or nerve), it is of the greatest importance to try to prevent or to diminish the transmission of any nervous influence from the diseased nerve or organ to the spinal cord. All the means usually employed to alleviate pain will be of service in such cases. If possible, we must try to paralyze for a time the sensitive nerves that convey the morbid influence to the spinal cord. Even a momentary suspension or diminution of the transmission of this influence may be very useful. Narcotics ought to be employed in injections—in the bladder, if that organ be the place from which starts that morbid influence; in the vagina, if the uterus be the place; and in the rectum, if the large intestine be the

place. Narcotics ought to be taken by the mouth if the stomach, the small intestine, or the kidneys are affected. In case of a pneumonia producing a reflex paralysis, inhalations of chloroform (which, by the way, have been successfully employed against the inflammation itself) may prove useful. We will say by and by what narcotics should be preferred.

2. The object of the means just proposed is to diminish the cause of the paraplegia; the object of the means we will now speak of is just the same, although it may seem to be quite different. Excitants or revulsives applied to the skin of the legs have been warmly recommended by Graves, who has obtained good results from their use. Probably the mode of action of these means consists in producing for a short time the same effect as the irritation which is the cause of the paralysis—*i. e.*, a contraction of the bloodvessels of the spinal cord; but, according to a well-established law, if such a contraction becomes considerable, the muscular fibres are soon exhausted, and a relaxation of the contracted fibres takes place, and, as a consequence of this relaxation, a dilatation of the bloodvessels occurs. Of all the causes of irritation capable of producing a contraction of bloodvessels by a reflex action, none has more power than cold. In consequence of this fact, I think some of the modes of application of cold to the spine (modes of which we will speak by and by), ought to be employed in cases of reflex paraplegia. But the excitation in those cases must be very powerful, and able to produce a very considerable degree of contraction, so that the

consequent exhaustion and dilatation may be obtained. With the same view, we may employ galvanism in the way we will soon describe.

3. Another important principle, or rather another part of the same general principle of treatment, consists in making use of the following means to increase the quantity of blood in the spinal cord: Every night, and often in the course of the day, the patient should lie down on his back, placing his head, his arms, and his legs on high pillows, so as to produce by gravitation a congestion in the spinal cord. This simple means, which is also applicable in cases of hysterical paraplegia, and in almost all the cases in which there is an insufficient amount of blood in the spinal cord, is just the reverse of what should be done in cases of inflammation or congestion of the spinal cord or its membranes, or of disease of the spine, &c., in which cases the patient ought to lie flat on the abdomen or on one side of the body, and have his feet and hands on a much lower level than that of the spine.

4. As regards the remedies to be taken by patients attacked with a reflex paraplegia, they must essentially be those which increase the amount of blood in the spinal cord, and augment the vital properties of this nervous centre, and also those remedies which render the blood richer in nutritive principles. We will soon indicate which are the best of these various remedies.

5. As regards food and the hygienic rules, patients attacked with a reflex paraplegia must have the most substantial aliments, so as to improve the deficient nu-

trition of the spinal cord. They must take a great deal of exercise in the open air, and especially make use, as much as possible, of the paralyzed muscles.

Before giving the details of the rules of treatment, we will sum up in the following propositions what we have just said:—

1st. Try to prevent, even for a short time, the continuation of the contraction of the bloodvessels of the spinal cord by the use of narcotics, to be applied as much as possible, to the organs from which starts the external cause of the paralysis.

2d. Try to produce by revulsives such a notable increase in the contraction of the bloodvessels of the spinal cord that an exhaustion of the contracted muscular fibres, and, as a consequence of this exhaustion, a dilatation of the bloodvessels, will soon take place.

3d. Have the spine placed much lower than the head, the arms, and the legs, when the patient is lying in bed, so as to increase the amount of blood in the spinal cord.

4th. Employ those remedies that have the power of augmenting the vital properties of the spinal cord in increasing the amount of blood in this nervous centre.

5th. Give the kind of food and employ those hygienic means that are most fitted for increasing the quantity of blood and for improving nutrition in all parts of the body.

On the one hand, experience has proved all these rules of treatment to be the most effectual; and, on the other hand, these rules are in perfect harmony with the theory

of the disease that we have given; so that experience and theory furnish a confirmation to each other.

The details of the treatment of the reflex paraplegia ought to be studied under the three following heads:—

1st. Means of diminishing the external irritation that causes the paraplegia.

2d. Means of improving the nutrition of the spinal cord.

3d. Means of preventing the ill effects of rest in the paralyzed nerves and muscles.

I. We have already said that narcotics should be employed against the external irritation that causes the reflex paraplegia. No narcotic is more powerful than belladonna locally employed to diminish pain or to prevent a reflex action. Unfortunately, for reasons that will be fully developed in the next lecture, it would be very unwise to make a constant use of belladonna in cases of reflex paraplegia. In cases of disease of the urethra or the prostate, an injection of a solution of one grain of the extract of belladonna, in twenty drops of laudanum, is to be made into the urethra, and the injection should be retained half an hour, or even an hour, after which some emollient decoction should be employed to wash away the rest of the narcotics. Every two or three days the same operation should be repeated. In the intervening days, I advise the use of an injection of thirty drops of laudanum, without belladonna. In cases of a disease of the bladder, I recommend the use of an injection into the bladder of a solution of one grain of the extract of belladonna, in twenty drops of laudanum,

just after a complete emission of urine. One day this injection is employed, and the next day twenty-five or thirty drops of laudanum alone are injected. When the prostate is very much enlarged, a suppository, covered with a belladonna-and-opium ointment, ought to be put, at times, in the rectum.

When the irritation that causes a reflex paraplegia starts from the vagina or the uterus, a pill of half a grain of extract of belladonna with one grain of extract of opium, surrounded by a piece of cotton wool, is introduced far into the vagina, and even up to the neck of the uterus. By means of a thread attached to the cotton, it is withdrawn as soon as the pain has ceased or much diminished. This simple means I have seen often employed with benefit by my learned teacher, Professor Trousseau, in painful affections of the womb, and I have myself made use of it with great advantage in two cases of reflex paraplegia and in several cases of hysterical paralysis.

In cases of a reflex paraplegia due to dysentery, colitis, or other morbid irritations of the large intestine, accompanied by diarrhœa, opium alone—*i. e.*, without belladonna—should be employed in enemata. In cases of paraplegia due to teething, if it coexists with enteritis, as it often does, opium is the narcotic to be employed, and it should then be taken by the mouth in very small but repeated doses. In cases of neuralgia producing a paraplegia, the narcotic that should be chiefly employed to relieve pain is opium, and so also in cases of paraplegia due to a disease of the stomach, the liver, the

kidneys, the pleuræ; but even in all these cases, belladonna may be used with profit if united with opium, if it is not often employed, and especially if strychnine is also used at the same time. I could not insist enough upon the importance of the necessity of never using belladonna without employing at the same time strychnine and opium, or at least strychnine, in cases of reflex paraplegia. I must repeat also that in this affection, when belladonna is employed, its use ought not to be a constant one; and, if the patients are not very costive, opium ought always to be the principal narcotic used to alleviate the external irritation that causes the paralysis.

II. The means of increasing the nutrition of the spinal cord may be placed into two groups—the medicinal and the physical. As regards the first group, we know but one remedy that really deserves confidence: it is strychnine.[1] We shall not discuss here the theories of the mode of action of this powerful poison and medicine; we shall only state our own views, and mention some of the principal facts concerning its action.

It is generally believed that strychnine acts on the spinal cord as an excitant, *i. e.*, in the same way as the application of galvanism, of heat, of a caustic, or a mechanical irritation. This is a great error; strychnine is not able to produce the least excitation on the spinal cord. The experiments of Van Deen, of Dr. Marshall

[1] Many poisons seem to act as strychnine does on the spinal cord, as we have ascertained by a great many experiments. Amongst these poisons are, morphia, nicotine, picrotoxine, cyanuret of mercury, sulphuret of carbon, chloride of barium, oxalic acid, &c. (See the thesis of my pupil, Dr. F. Bonnefin, "Recherches sur l'Action Convulsivante des Poisons," Paris, 1851.)

Hall, those I made ten years ago, alone, or with my pupil, Dr. Bonnefin, and those recently published by M. Martin-Magron, and M. Buisson, in their most important paper, "On the Comparative Action of Woorara and Strychnine,"[1] cannot leave the least doubt on this point. It is only in increasing the reflex faculty of the spinal cord that strychnine seems to cause convulsions. This vital property of the cord reaches such a very high degree, that any external or internal excitation brings on a reflex tetanic contraction, the violence of which, according to a well-known law, is in proportion to the degree of the reflex faculty. So long as the spinal cord does not receive some kind of excitation, however powerfully poisoned by strychnine it may be, there is no convulsion. I have seen frogs, deprived of respiratory and voluntary movements (after the extirpation of the brain and the medulla oblongata), remaining hours, days, and even a week, without the least convulsion so long as they were not touched, although they were poisoned by a large dose of strychnine; but the least touch produced in them the most powerful reflex tetanic spasms.

How does strychnine act to produce this augmentation in the vital property of the spinal cord? In two distinct ways—1st, in increasing the amount of blood in the spinal cord; 2dly, in acting in a special and direct manner on the tissue of the cord. As regards the first mode of action, we shall only state here that it is a positive fact that the quantity of blood circulating in the spinal

[1] See Journal de la Physiologie de l'Homme, &c., Nos. vii. and viii. 1859, and Nos. ix. and x. 1860.

cord is very much increased, and that consequently its nutrition is also increased. As regards the second mode of action, the admirable researches of MM. Martin-Magron and Buisson have established beyond doubt, that even when the spinal cord does not contain any blood, strychnine directly applied upon, or in that organ, increases so much its vital property that reflex tetanic spasms may be produced.

These two modes of action of strychnine explain how this alkaloid acts in cases of reflex paraplegia. The amount of blood in the spinal cord, and the reflex faculty of this organ, are very much diminished in this affection. Therefore strychnine must have a great curative power in such a malady, and it must be employed with persistence so long as the paraplegia lasts. The teachings of theory in this respect agree perfectly with those of practice, as there are a great many cases observed by others or by myself, which I might relate, to show the therapeutical power of strychnine in the reflex paraplegia.

When used together with opium, the dose of strychnine must be a small one, *i. e.*, from one-fortieth to one-thirtieth of a grain a day. When used alone, its dose may be one-twentieth of a grain a day. When employed together with belladonna, the dose must be larger on account of the antagonistic action of belladonna on the spinal cord.

We shall insist, by and by, on the importance of making use of strychnine persistently in almost all cases of paraplegia in which there is no inflammation or no congestion of the spinal cord or its membranes. We

shall only say now, that the use of this remedy ought to be suspended, for a few days, whenever it produces spasms.

Besides strychnine, there is another remedy which has often proved useful in cases of reflex paraplegia; it is sulphur. Graves employed it internally; we prefer, with several French physicians, to employ it in a bath, so that, on the one hand, we avoid its influence upon the functions of the digestive canal, and, on the other hand, we have the benefit of its stimulative action on the skin. It is the sulphuret of potash which is made use of in that way; four or five ounces for the ordinary amount of water for a general bath. A wooden or zinc bath ought to be employed, instead of the common tin bath.

The other means to be employed with the view of improving nutrition in the spinal cord, are the following:—

1st. *Position of the Patient in Bed.*—I have seen benefit result, in three cases of reflex paraplegia, and in two cases of hysterical paraplegia, from having directed the patients to lie flat on the back in a soft and warm bed, while the head and upper limbs and the bend of the knees were placed on high and hard pillows. In these cases there was a marked diminution of the paralysis every morning, and also, though in a less degree, in the course of the day, after the patients had assumed that position for one or two hours. This result, which I expected from the theory of these affections, may be readily explained if we admit that theory. We suppose there is a contraction of the bloodvessels of the spinal

cord, and it is therefore easy to understand that, by diminishing the amount of blood in the head and limbs, we force, as it were, through the agency of gravitation, a larger quantity of this fluid through the bloodvessels of the spinal cord, and consequently increase the nutrition of this organ.

2d. *Application of Cold and Heat to the Spine.*—To those patients who can bear the application of very cold water to the spine, I prescribe the use of a douche thrown with great force all along the dorsal and lumbar regions of the spine. The douche should be applied for one minute or a minute and a half; it ought to be supplied with a small jet, and the temperature of the water should be between 40° and 50° Fahr. I need hardly say that the spine must be rubbed hard with a warm flannel immediately after the application of the douche. In patients who cannot bear the cold douche, a very warm douche should be made use of. I sometimes make use of alternate applications of cold and heat, either with sponges—one soaked with ice-water and another with water at 100° Fahr.—or a towel folded somewhat like a cravat, the two ends of which are wet, one with ice-water, the other with warm water; the spine being struck with either end of this towel alternately.

3d. *Application of Revulsives.*—Graves, Leroy d'Etiolles, Jr., and all the writers on the reflex paraplegia, agree in stating that revulsives, issues, &c., applied on or near the spine, are utterly useless. I would not go so far; but I can state that they are hardly worth the trouble they may give. Graves insists upon the import-

ance of the application of revulsives to the skin of the lower limbs. There is no doubt that applications of croton oil, of mustard poultices, of blisters, &c., to the skin of the thigh or of the calf of the leg, have often been employed with apparent benefit in the reflex paraplegia.

4th. *Application of Galvanism to the Spine.*—If we could pass a powerful current through the spinal cord, this mode of treatment would certainly prove very useful in the reflex paraplegia; but, as shown by the experiments of Dr. F. Bonnefin,[1] we can hardly succeed in really passing a weak current through the cord; it is almost entirely through the excitation of sensitive nerves and a reflex action that we act upon the nutrition of the cord by galvanism. In those patients who can bear pain, a very powerful excitation of the skin along the spine, by interrupted currents, may be of service.

III. The means of preventing the ill effects of rest in nerves and muscles, which would naturally take place in proportion to the degree of the paralysis, consist essentially in the application of galvanism and of shampooing to the lower limbs in cases of reflex paraplegia. To avoid muscular atrophy, and the consequent diminution of irritability, in that kind of paralysis as well as in almost any other kind, it is also of the greatest importance to apply galvanism to the paralyzed muscles. Two or three applications, of ten minutes each, in a week, may be sufficient, especially if shampooing be employed.

[1] Journal de Physiologie, No. III., 1858, p. 545.

Besides the above means, it is of the utmost importance that the remainder of the voluntary power over the paralyzed parts be exercised frequently, and also that the heat of the lower limbs be maintained or increased by artificial means.

As regards hygienic rules and some other details of treatment, they will be mentioned in the next Lecture, when I treat of various kinds of paraplegia which require nearly the same treatment as the reflex paraplegia.

In concluding this Lecture we ought to repeat that all the means to be employed against the reflex paraplegia would be almost useless, or only produce a temporary benefit, if the affection which has caused this paralysis is not cured, or at least diminished in its intensity.

LECTURE III.

DIAGNOSIS AND TREATMENT OF PARAPLEGIA DUE TO MYELITIS, MENINGITIS, OR A SIMPLE CONGESTION.

Opposition between the kind of paraplegia depending upon a diminution of blood in the spinal cord and those kinds in which the amount of blood is increased.—Spinal epilepsy in cases of inflammation localized in the dorsal region of the spinal cord.—Symptoms of inflammation in the part of the cord from which originate the nerves of the lower extremities, and a little higher.—Differences in the symptoms of inflammation according to the part of the spinal cord where it exists.—Inflammation of the gray matter, and of the posterior or the anterior columns.—Symptoms of chronic meningitis.—Symptoms of congestion of the spinal cord and its membranes.—Mode of production of paralysis, cramps, anæsthesia, sensations referred to paralyzed parts, alterations of nutrition, &c., in myelitis, meningitis, and spinal congestion.—Prognosis of myelitis.—Treatment of myelitis.—Action of belladonna and of ergot of rye upon the spinal cord.—Cases of myelitis in which iodide of potassium may be of service.—Prevention of sloughs in myelitis and other cases of excitation of the spinal cord or its nerves.—Prognosis and treatment of meningitis and spinal congestion.

Gentlemen: There are three affections of the spinal cord or its membranes, which resemble each other by some of their symptoms, and require the same general mode of treatment. These affections are—the congestion of the cord and its membranes, the inflammation of the spinal meninges, and the inflammation of the spinal cord. The kind of paraplegia due to these three affections is essentially distinct from the paralysis described in the two preceding lectures. It is of the utmost importance to establish clearly the distinguishing features

of these two kinds of paraplegia, as the treatment that may prove useful in the one may be most injurious in the other. Therefore, although we have already much insisted upon the diagnosis of these two kinds of paraplegia, we may be allowed to make here some additions to our previous remarks.

The principal features of a reflex paraplegia depend upon a diminution in the quantity of blood in the spinal cord. The reverse exists in cases of congestion or inflammation of the spinal cord or its membranes, cases in which the characteristic symptoms accompanying the paraplegia depend upon an augmentation in the quantity of blood in the spinal cord or its membranes. The whole history of these two kinds of paraplegia, both as regards the symptoms and the treatment, leads forcibly to that most important distinction as respects the amount of blood in the spinal cord. In consequence of the diminution of the quantity of blood in this nervous centre in cases of reflex paraplegia, there is a diminution of its vital properties; while, in cases of congestion or inflammation of this centre or its membranes, we find, in consequence of the augmentation in the amount of blood, a notable increase in the vital properties of the spinal cord or of its nerves.

We now come to the history of the symptoms and treatment of myelitis, of spinal meningitis, and of the congestion of the spinal meninges.

Local Myelitis.—As our object in these lectures chiefly consists in the study of paralysis of the lower extremities, we will leave aside altogether all that relates to myelitis

in the cervical region or the upper part of the dorsal region, in which cases the upper limbs are paralyzed as well as the lower. We will first speak of myelitis limited to a small extent of the dorsal region in its middle part, and then contrast it with the myelitis of the lower part of the spinal cord.

Although not so frequent in a very limited part of the dorsal region as in the dorso-lumbar enlargement, an inflammation of that very limited part of the spinal cord is not a rare occurrence. In less than a year I have seen five or six cases of this limited myelitis. The most characteristic symptom of this kind of myelitis consists in frequent fits of very violent spasmodic movements in the lower limbs. Whether spontaneously or after an external irritation (such as a shock or a pressure on some muscles, tickling of the sole of the foot, or the passing of a catheter into the urethra), the lower limbs are often moved violently, or become perfectly stiff; sometimes they are drawn up forcibly in a state of flexion, the back part of the foot pressing against the hip-joint; sometimes the thighs are drawn violently one against the other by a spasm of the adductor muscles, and they press very hard against the testicles; in other cases, the flexor and extensor muscles contract alternately with great violence, and, after a few minutes of great shaking, a rigid condition appears, which, after a time, is followed by relaxation and quietness.

This spasmodic affection of the paralyzed legs is the result of the morbid increase in the vital properties of the dorso-lumbar enlargement of the spinal cord, owing

to two causes: 1st, the congestion of that part of the cord; 2dly, the accumulation of power in that part in consequence of its not being any more under the action of the will.[1]

In cases of fracture or luxation of the spine, or of tubercle or other tumors pressing against the spinal cord, the same convulsive movements, as in cases of myelitis limited to a small part of the dorsal region of the cord, may exist. Most likely the condition of the dorso-lumbar enlargement of this nervous centre is pretty nearly the same in all those cases. After a transversal section of the posterior part of the spinal cord and of its gray matter in the dorsal region, in dogs and other animals, the same spasmodic movements are observed in the hind legs, either spontaneously or after some external irritation. I have ascertained that the application of cold to the skin, or the pressure upon some of the paralyzed muscles, are the most powerful means of exciting those spasms.

I need hardly say that in cases of local myelitis, whether in the cervical region or in the upper part of the dorsal region, spasmodic movements may also be observed in the lower limbs. In consultation with Dr. A. P. Stewart, I saw some time ago a case of this last kind of local myelitis. In this case, as usual, but with more frequency than in the other cases I have seen, the fits of spasms occur especially when the patient is lying down, asleep or not.

[1] I produce easily this condition of a part of the spinal cord in animals. (See Journal de la Physiologie, vol. i. 1858, p. 476.)

We think that in cases of inflammation of the dorso-lumbar enlargement this spasmodic affection of the paralyzed lower limbs will not be observed except in circumstances to be mentioned hereafter, and, therefore, that this symptom coexisting with symptoms of myelitis may clearly show that the seat of the inflammation is above the dorso-lumbar enlargement. This enlargement has been found softened, and even completely disorganized,[1] in cases in which these spasmodic movements have been observed. I must say that those cases ought not to be considered as proving that, although deeply altered, the lower part of the spinal cord is able to produce these convulsions. The truth is, that when the softening took place, the convulsive movements soon ceased. However, we ought to say that at the same time that an acute inflammation begins in the lower part of the spinal cord convulsive movements in the legs may take place; but it must be remembered that they soon cease; while in cases of inflammation of the spinal cord, in the middle of the dorsal region or above, convulsions do not take place at the beginning of the inflammation, but some time after, and they recur, by fits, for months and years afterwards.

We will only add with regard to the interesting symptom consisting in fits of spasm in the lower limbs, that it may exist also in certain stages of meningitis, as we will show hereafter; and that it deserves the name

[1] See a case by Mr. Madden ("Diseases and Derangements of the Nervous System," by Dr. Marshall Hall, 1841, p. 237), and other cases in an interesting paper by Dr. W. Budd (Medico-Chirurg. Trans., vol. xxii., 1839, pp. 168–170).

of *spinal epilepsy* much more than the epilepsy due to a disease of the spinal cord, the symptoms of which do not differ essentially from those of the epilepsy due to a disease of the cerebral meninges, of the kidney, or of any other organ in the body.[1]

My experiments upon animals clearly show that a marked degree of paraplegia and a notable congestion of the dorso-lumbar enlargement are two circumstances that seem to be necessary for the existence of the fits we have described of spasmodic movements, or rigidity in the lower limbs. These experiments also show that when a state of congestion is replaced by a real inflammation in the lower extremity of the spinal cord, the fits of spasm soon cease. So that in those cases of paraplegia in which there are symptoms of inflammation in the dorsal or dorso-lumbar parts of the spinal cord, we may know which of these parts is the seat of the inflammation by the existence or the absence of frequent fits of general spasms in the various parts of the paralyzed limbs. I have insisted upon this point because, as will be shown hereafter, it is important, both for the prognosis and the treatment, to know the seat of an inflammation in the spinal cord.

We will not speak here of the acute myelitis accompanied by fever, as in almost all cases of that kind there is at the same time an acute inflammation of the spinal meninges. We only intend to show now what the symptoms are in those cases of paralysis of the lower limbs of long standing that depend upon a chronic in-

[1] See my "Researches on Epilepsy," Boston, 1857, p. 28.

flammation of a part of the spinal cord in the middle or lower parts of the dorsal regions.

The characteristic symptoms of this local myelitis are:—

1st. A constant pain at the part of the spine corresponding with the upper limit of the inflammation of the cord.

2d. Whether a constant pain exists in a very marked degree or not, it is almost always found that pressure upon the spinous process of the vertebræ (sometimes even a slight one), when made at the upper limit of the inflammation, causes an acute pain.

3d. The passage of a sponge, filled with warm water, along the spine, gives a normal sensation of heat in all the parts above the seat of the inflammation, but a burning sensation at its upper limit.

4th. The passage of a small lump of ice along the spine gives the natural sensation of cold everywhere, except at the level of the inflammation, where the sensation is that of burning.

5th. Most patients complain much of a sensation as if there were a cord, or some other ligature, tied around the body, at the limit of the paralysis. In a few patients there is but a very slight sensation of that kind. This symptom seems to exist in all cases of myelitis, and to depend chiefly, but not entirely, upon a state of cramp of some part of the muscles of the abdomen or the chest.

6th. Various sensations, resembling very much those which follow the pressure upon a nerve, such as formi-

cation, pricking by pins and needles, and sometimes a feeling of burning or intense cold in the feet, legs, and thighs, less frequently in the abdominal walls. These sensations exist with as much, if not with greater, violence, in parts deprived of sensibility, as in parts which are still sensitive. They originate from the irritation of the gray matter of the spinal cord, and are *referred* to the limbs and abdomen, just as the pressure upon a nerve produces sensations in its ramifications. They are important indications of myelitis.

7th. Cramps in the feet or calf of the legs are very frequent. There are more or less of them in every patient. Frequently there are cramps also in the large abdominal muscles, besides the circular and linear cramp that gives the above-mentioned feeling of tightening. A cramp limited to a part of one or several abdominal muscles may remain almost permanently for days and weeks, forming a kind of lump, which may be mistaken for a tumor.

8th. Whether myelitis exists only in a small zone of the spinal cord, or occupies the whole of the dorso-lumbar enlargement, the paralysis of movement exists in all the parts of the body that receive their nerves from the portions of the spinal cord that are below the upper level of the inflammation. The degree of paralysis varies extremely in different patients, but it is nearly the same in the various muscles of the lower limbs in the same patient.

9th. Paralysis of the bladder and of the sphincter ani is almost always present in inflammation of the lower

part of the dorsal region of the spinal cord; but when the seat of the inflammation is higher up in the dorsal region, there is rather a spasm than a paralysis in the sphincters of the bladder and anus. Often then there is retention of urine, owing to the paralysis of the bladder, while the sphincter vesicæ is more or less in a spasmodic state.

10th. One of the most decisive symptoms of myelitis is the alkalinity of the urine. There is no patient attacked with myelitis in the dorsal region of the cord whose urine is not frequently alkaline. At times, especially after certain kinds of food, the urine is acid, but the alkalinity soon reappears.

11th. Anæsthesia, or at least a diminution of sensibility, always exists in myelitis, except when the gray matter is not the seat of the disease, which is very rare. Usually, the inflammation begins in the central parts of the gray matter, and then a diminution of sensibility is one of the first symptoms. That peculiar kind of sensibility of muscles which serves to direct our movements is especially impaired in the very beginning.

12th. When the dorso-lumbar enlargement is inflamed, reflex movements can hardly be excited in the lower limbs, and frequently it is impossible to excite any. On the contrary, energetic reflex movements can always be excited when the disease is in the middle of the dorsal region, or higher up.

13th. It is frequent to find sloughs formed upon the sacrum or the nates, even before the patient has long been bedridden.

The very striking symptoms of myelitis which we have described do not always exist in a very marked degree. According to differences in the seat of inflammation in the spinal cord, there are great differences in the intensity of the symptoms, and, still more, some of them may be missing. When the gray matter of the spinal cord is the seat of the inflammation, all the characteristic symptoms exist, and to a notable degree; but in those rare cases in which the inflammation is limited to the white columns of the spinal cord, there is a marked difference from the preceding kind of myelitis. If the posterior columns be the seat of inflammation, the symptoms are much less marked, but they all exist. When the disease is in the anterior columns, there is no anæsthesia, and the morbid sensations *referred* to the paralyzed parts of the body hardly exist.[1] We will return to this subject when we speak of the paraplegia due to pressure upon the spinal cord by a tumor, a displaced or broken bone, &c., and we pass now to the history of paraplegia due to a chronic meningitis.

Chronic Meningitis.—The paraplegia due to this cause presents several characteristic features, of which we will say but very little, on account of the usual facility of diagnosis. These features are the following:—

1st. Pain usually of a rheumatic character, and more or less diffused along the spine. Generally there is no great increase of this pain when pressure is applied on

[1] For details of the symptoms of disease of the various white columns of the spinal cord, see Lects. v., vi., vii. and viii. of my "Lectures on the Central Nervous System," Philadelphia, 1860.

the spinous processes, as in cases of myelitis; while on the contrary, every movement of the spine forward, backward, or laterally, increases the pain, sometimes to a very great degree.

2d. The nerves originating from the part of the spinal cord where the meninges are inflamed are the seat of acute pain, which is very much increased by mechanical causes. The sciatic nerves, for instance, when meningitis exists in the lower part of the spine, seem to be the seat of very great pains, which are much increased when the lower limbs are moved. When inflammation is confined to the part of the membranes at the place where the nerves of the upper limbs originate, the movements of these limbs cause great pain.

3d. There are frequent, and in some cases constant, spasms in the muscles of the back. Those spasms which render the spine almost immovable are produced or increased when an attempt is made to move the trunk. When they exist in the cervical region they bend the head backwards, just as in tetanus.

4th. In cases of meningitis, the degree of paraplegia may vary from the very slightest to the most complete. Sometimes a slight paraplegia increases and then diminishes rapidly, owing to rapid changes in the quantity of the cerebro-spinal fluid or to the degree of congestion that accompanies the inflammation of the meninges.

5th. Anæsthesia is very rare in spinal meningitis. Sometimes there is a real hyperæsthesia, or at least a morbid sensibility and an increased susceptibility to reflex movements.

6th. A curious symptom is a spasm of the sphincter of the bladder, which prevents the evacuation of the urine. In some cases this spasm is followed after some time by a paralysis of the sphincter.

These symptoms are sufficient to characterize meningitis in a chronic and even in a subacute state. We will say a few words more hereafter on the diagnosis of this affection.

Congestion of the Spinal Cord and its Meninges.— Several of the symptoms which coexist with paraplegia in cases of myelitis or meningitis are often observed in cases of simple spinal congestion, as shown by Ollivier d'Angers, in his important work on the spinal cord.[1] This affection is frequently produced in cases of suppression of the menses or of the lochiæ, and of disease of the liver and other abdominal organs in which there is some obstacle to the return of blood from the spinal cavity. The paraplegia caused by excesses of sexual intercourse very often depends upon a congestion of the spinal bloodvessels. It is very rare that this congestion exists without an increase in the amount of the cerebro-spinal fluid, so that two causes then coexist to produce the paralysis of the lower limbs.

The symptoms which characterize a spinal congestion are the following:—

1st. Formication, alternating with numbness, especially in the beginning of the affection. The skin of the toes and fingers are the principal places where for-

[1] Traité des Maladies de la Moëlle Epinière, vol. ii. pp. 1–90. Paris, 1837.

mication appears, but it often exists in various portions of the skin in the paralyzed parts.

2d. Only a slight pain in the spine, hardly increased by pressure.

3d. Frequently a morbid increase of sensibility, even when there is numbness.

4th. In many cases the power of moving the paralyzed lower limbs is much greater when the patient lies down than when he stands up, which is due, however, not to the difference in the degree of congestion, but to the cerebro-spinal fluid, the amount of which in the lower part of the spinal cavity is greater when the patient stands up than when he lies down. On the contrary, the congestion of the spinal bloodvessels increasing when the patient is lying down, especially when he lies on his back, it is observed that the degree of paralysis is notably increased after a night's rest, when the patient first gets out of bed, and tries to stand on his feet and to walk. The fact that the degree of paralysis is always greater then than in the course of the day, when the patient does not lie down in the daytime, is one of the most important symptoms of spinal congestion.

5th. The bladder and the rectum, and their sphincters, are usually more paralyzed in this affection than in cases of paraplegia due to most other causes.

6th. An ulceration upon the sacrum or nates is not rare in this affection.

7th. Slight spasmodic movements are sometimes observed in some of the paralyzed muscles.

8th. It is usually difficult, and very often impossible, to produce reflex movements in the lower limbs.

9th. Usually the paralysis is not limited to the lower limbs: when it begins in them, it rapidly extends to the upper limbs, and to some of the respiratory muscles, and when it begins in the upper limbs, it quickly reaches the lower ones.

To understand well what we have said of the symptoms of paraplegia caused by myelitis, meningitis, or a simple congestion of the spinal cord and its membranes, it is important to bear in mind the following facts:—

1st. That the gray matter of the spinal cord in its normal condition is not at all *excitable*, and that irritations upon it are not followed by sensations or movements; while, on the contrary, when inflamed, it is excitable and able to give all kinds of sensations, and to produce cramps or partial convulsions.

2d. That the white matter of the spinal cord is not composed of motor and sensitive fibres coming from or going to the brain.

3d. That a pressure upon the spinal nerves, or upon the inflamed spinal cord, able to produce a paralysis accompanied by cramps, may either produce anæsthesia or not, while it causes various sensations.

It is easy to understand the analogies and differences presented by myelitis and spinal congestion, when we remember the above facts, taking notice also of certain circumstances, such as the increased quantity of the cerebro-spinal fluid, the reflex influence arising from the inflamed meninges, etc.

In myelitis, the gray matter of the spinal cord acquires the same properties as a nerve of sensibility and movement; and all the effects of pressure upon such a nerve are observed. In fact, the spinal cord is then just like a large compound nerve, comprehending the various nervous fibres that originate from it, not only at the place inflamed, but also most of those fibres which proceed from the parts of the cord below the seat of the disease. In consequence of this new condition of this nervous centre, the causes of excitation developed in inflammation (pressure by effused liquids, &c.) produce the various phenomena belonging to the three principal kinds of nervous conductors existing in the spinal cord; and several effects are then produced which are also observed in meningitis and in spinal congestion, owing to pressure upon the spinal nerves. It is interesting to compare, as we will do, myelitis, meningitis, and spinal congestion, as regards the phenomena belonging to these three kinds of nerves.

1. *Alterations of Motor Conductors.* — Paralysis and cramps are the results of excitations of these conductors. The degree of paralysis in meningitis and in spinal congestion is different from that existing in myelitis, on account of the mode of its production. In myelitis, the number of motor conductors submitted to alterations is much larger, and also the degree of excitation is greater, than in spinal congestion and meningitis; so that both the degree of paralysis and the frequency of cramps are greater in the first than in the last two affections. A pressure upon the spinal nerves in the narrow canals by

which they pass out of the spinal cavity is the chief cause of paralysis in cases of meningitis and spinal congestion. This pressure being very variable, according to circumstances, great variations exist in the degree of paralysis. The rigid spasm of the muscles of the back in meningitis seems to be due to a reflex action, as in tetanus.

2. *Alterations of Conductors of Sensitive Impressions.*— It is extremely interesting to witness the variety of sensations referred to paralyzed parts in cases of myelitis. All the sensations that we may have, in health, in the skin, muscles, and other parts, may then be generated in the cord itself, although they are felt as if they came from the skin, muscles, &c.; and it is well known that this fact may be observed even when the skin and other parts are completely deprived of sensibility. In cases of spinal congestion and of meningitis, not complicated with myelitis, the *referring* of sensations to the skin and other parts is almost null. It might seem strange that a pressure upon nerves of sensibility and movement should be sufficient to produce paralysis, with or without cramps, and not be able to generate those sensations which are so easily produced by a pressure upon the ulnar nerve at the elbow; but, as I have tried to prove eight years ago,[1] nerve-fibres able to transmit sensitive impressions may or may not be excitable and able to give origin to sensations. In some parts they are excitable, in others they are not; and, therefore, the ab-

[1] See my "Experimental Researches applied to Physiology and Pathology," New York, 1853, p. 98.

sence or slight degree of sensations referred to the skin, muscles, &c., in cases of meningitis, only show that the conductors of sensitive impressions, in their passage out of the spine, where they are subjected to pressure, are not excitable, or, at least, that they have but a slight excitability.

3. *Alterations of Vaso-Motor Nerves.*—It is not the place here to insist upon the distinction between the effects of a paralysis and those of an excitation of the vaso-motor nerves.[1] We will only state that in the three affections we are now comparing, the most important feature is, that there are striking effects of excitation of these nerves. In myelitis, especially, these effects are very marked; the alteration in the urine, the formation of sloughs on the sacrum, the nates, &c., the serous infiltration in the subcutaneous cellular tissue, the rapid atrophy of the paralyzed muscles, the dryness of the skin, &c., are phenomena that clearly indicate a great excitation of the vaso-motor nerves of the paralyzed parts. In cases of spinal congestion and of meningitis, it is not rare to observe these alterations of nutrition, but they are usually to a less marked degree than in myelitis. One of the most interesting effects of excitation of the vaso-motor nerves in myelitis—*i. e.*, the alkalinity of the urine—does not exist in meningitis nor in spinal congestion. It is not rare in these three affections that, near a place where some effect of *excitation* of the vaso-motor nerves is observed, there are effects of

[1] See, for this distinction, my "Lectures on the Central Nervous System," Lects. X. and XI., Philadelphia, 1860.

paralysis of these nerves, such as a dilatation of blood-vessels, increased heat, and sometimes an abundant perspiration.

Prognosis of Paraplegia due to Myelitis.—Myelitis, either chronic or acute, has long been considered as an almost incurable disease. It is true that in a very acute form this inflammation is almost always fatal. Not so, however, as regards the subacute or chronic myelitis if it exists in the lumbar or the dorsal regions, where this inflammation is most frequently located. Chronic myelitis is an affection of slow development, and still slower progress. When not properly treated it extends gradually upwards, and slowly causes a more and more complete paraplegia; but it destroys life only after several years of paralysis. I have known a case in which it lasted twenty-one years. When properly treated, myelitis is very frequently stopped in its progress, and sometimes an almost complete cure may be obtained. Out of nineteen cases now under my care in private or in hospital practice, there are three in which there has been rather an increase of the affection than an amelioration; two in which the amelioration approaches to a cure; seven in which there is a marked amelioration, though less than in the preceding; two in which, after a decided improvement, a relapse has occurred; and five in which the treatment has not yet been employed for a sufficient time to lead to any opinion as to its efficacy.

From these facts, and also from the effect of the treatment in many cases under my care, or that of several medical men who, during the last few years, have em-

ployed the means of treatment I have proposed, it results that the prognosis of the chronic, or even the subacute, form of myelitis should be considered as much less grave than it has been until lately. However, it is true that when the affection is altogether stopped in its progress, and when many of the symptoms have ceased to exist, the paraplegia remains, although the inflammation of the spinal cord may be cured. The patient can command the motions of his bladder, he may walk as much and almost as fast as he could before he was attacked with myelitis, without feeling fatigue; but however great may be the amount of his motor power, he cannot *direct* his movements so well as can be done by even a very weak but healthy man. This is due to the fact that some of the alterations caused by myelitis in the spinal cord are almost irreparable.

Treatment of Chronic Myelitis.—I. The first and most important rule is to diminish the congestion of the spinal cord. For this purpose the various following means ought to be employed:—

1st. If possible, the patient should never lie on his back. Whether at night or in the daytime, if he lies down, he ought to place himself on the right or the left side of the body, and, if he can, he should even lie flat on the abdomen, so as to diminish by the effect of gravitation the amount of blood in the spinal cord. At the same time his arms and legs ought to be covered with flannel, and placed on a lower level than that of the spine, for the purpose of attracting blood to them. If the patient cannot avoid lying on his back, he must have

a hard bed, or at least not a feather bed. I need hardly say that a water-bed will be necessary if there is any appearance of ulceration or sloughing on the nates or the sacrum.

2d. Applications to the spine of those means that may attract blood outside of the spinal canal should be made as often as possible. Perhaps the best means is the application of a hot douche to the spine. The water ought to fall from at least four or five feet through a tube three-quarters of an inch or one inch in diameter. Its temperature ought to be between 98° and 101° Fahr., and the application should be continued two or three minutes and repeated every day. The cold shower-bath may also be employed with advantage, if, immediately after it, the spine be rubbed with a warm flannel, so as to produce a dilatation of the bloodvessels of the skin and muscles of the back.

3d. Dry cupping applied daily, alternately on the various parts of the spine, will prove of service if its use be persevered in for a long while.

4th. The applications of blisters, moxas, cauteries, &c., may certainly be useful; but the pain they give, and the danger of their being the origin of a slough, ought to be taken into great consideration. I generally prefer employing the hot douche and dry cupping. However, where the myelitis is caused by a caries or some other organic affection of the spine, applications of the actual cautery, or of moxas, and other local revulsives on the diseased spot of the spine, are to be preferred to the simpler means (hot douche, cupping, &c.).

5th. Amongst the remedies to be employed internally, the most active are those which have the power of diminishing the congestion of the spinal cord. The two which seem to be most powerful in this respect are belladonna and ergot of rye. Experiments upon animals have shown to me, in the most positive manner, that these two remedies are powerful excitants of unstripped muscular fibres, in bloodvessels, in the uterus, in the bowels, &c. Both of them dilate the pupil; both are employed with success to produce contractions of the uterus; but each of them has more power in certain parts than the other, so that we find belladonna acting more than ergot on the bloodvessels of the iris (which is the principal cause of the dilatation of the pupil)—on the bloodvessels of the breast (which is the principal cause of the cessation of the secretion of milk)—on the muscular fibres of the bowels (which is the mode of its action in cases of strangulated hernia)—on the sphincter of the bladder (which is one of the causes of its success against nocturnal incontinence of urine), &c.; while, on the contrary, we find that ergot acts more than belladonna on the muscular fibres of the womb, on the bloodvessels of the spinal cord, &c. We cannot give here the proof of the exactitude of these assertions on the mode of action of these two remedies, but we must at least answer an objection which probably will arise in the mind of many persons. It will be asked—How is it that, of two remedies that are able to excite contractions in smooth muscular fibres, one produces them more in one place, and the other more in another place? The

answer to this objection is indeed very simple. The excitability of smooth fibres, as well as that of striated muscles, varies exceedingly in different parts of the body. An exciting agent (whether galvanism, cold, heat, or belladonna and ergot of rye) will produce powerful contraction in some places, and hardly any in other places. The smooth fibres of the uterus contract more than those of the bowels or the bladder, and less than those of certain bloodvessels when stimulated by galvanism; the smooth fibres of certain bloodvessels contract more than those of the uterus under the excitation of cold; still more, the bloodvessels of the cerebral lobes and of the face, which contract so much when their nerve (the cervical sympathetic) is irritated, contract but very little when excited by belladonna and ergot, while these two excitants produce powerful contractions in the bloodvessels of the spinal cord.

Not only have I seen the diminution in the calibre of bloodvessels of the pia mater of the spinal cord taking place in dogs after they had taken large doses of belladonna or ergot of rye, but I have also ascertained that the reflex power of the spinal cord (most likely as a consequence of the contraction of bloodvessels) becomes very much diminished under the influence of these two remedies, which in so doing act just in the opposite way to that of strychnine.

Led by the knowledge of the above facts, we have employed belladonna and ergot of rye in cases of paraplegia due to a simple congestion or a chronic inflammation of the spinal cord and its meninges, and we have

obtained a greater success than we had dared to hope for. Whatever be the value of our experiments on animals as regards the mode of action of these remedies, it is now certain that they have really a great power in diminishing the amount of blood in the spinal cord and its membranes. It is very well known that many French physicians, especially Bretonneau, Payan, Barbier, and Trousseau, have for many years employed with success belladonna and ergot of rye in cases of paraplegia. Of course we do not claim to have been the first to make use of these remedies in paraplegia, any more than we claim priority as regards employing strychnine in various forms of paralysis. But we claim to have pointed out, as clearly as we could, in what cases of paraplegia strychnine or belladonna and ergot of rye are to be employed or avoided. To indicate this distinction is the principal object of these lectures.

In the beginning of the treatment of chronic myelitis, we usually employ ergot of rye alone internally, and belladonna externally in a plaster applied to the spine, over the painful spot. The dose of ergot, when the powder is used, which is almost always the case, is at first three grains twice a day; gradually the dose is increased until it reaches six grains twice a day. In a few cases we have given eight grains twice a day, but we do not think it is necessary to make use of the very large doses employed by M. Payan. The belladonna plaster applied to the spine must be a very large one, four inches wide, and six or seven inches long. If there is no amelioration in a few weeks, we give the extract

of belladonna in doses of a quarter or a third of a grain twice a day.

When we find that the patients, after six or eight weeks of treatment by ergot of rye and belladonna, do not get better, we give iodide of potassium in doses of five or six grains twice a day, in addition to the preceding remedies. When there is any reason to suspect that there is a degree of meningitis together with myelitis, we begin at once the treatment by the iodide of potassium with the ergot and belladonna.

II. The second rule of treatment of myelitis is to prevent the formation of sloughs, or to cure them when formed, and to prevent other alterations of nutrition in the paralyzed parts.

1st. Ulcerations and sloughs on the nates, the sacrum, or other parts, may be prevented or stopped in their development, if they have not acquired a great extent, by very simple means, which I have found perfectly successful in experiments upon animals. Led by the view that sloughs are chiefly due to an irritation of the vaso-motor nerves, producing alterations in the nutrition of certain parts of the skin, I have thought that alternate applications of cold and heat to the parts where there is a threatening of sloughing, by acting upon the bloodvessels, so as to produce in them considerable contractions and dilatations, might prevent the effects of the irritation of the vaso-motor nerves in the spinal cord; and the success I have obtained shows that this view is probably quite right. The means I propose is the alternate application of pounded ice in a bladder,

and a warm poultice, the ice to be left ten minutes, or even less, and the poultice an hour. It is in cases of fracture of the spine, followed by myelitis, that I have employed these means; but hitherto only on animals. I hope surgeons will soon decide what is the real value of this means in man.

2d. To prevent the alterations of nutrition (œdema, atrophy, &c.) in the paralyzed limbs in myelitis, the best means are, shampooing, applications of galvanic currents, and the use of the flesh-brush. When there is no œdema, a warm foot-bath every night is of service in those cases where the feet are very cold.

3d. The morbid alterations in the kidney and bladder may be prevented or alleviated by the exhibition of liquor potassæ, turpentine, copaiba, tolu balsam, &c. We need hardly say, that if nephritis or cystitis occur, it should be treated energetically.

4th. The bowels must be kept open, on account of the increase of the congestion of the spinal cord that results from constipation. The narcotics which produce constipation and congestion of the spinal cord, especially opium, should be avoided; and, in case of sleeplessness, hyoscyamus, conium, lactuca virosa, and cannabis indica, are amongst the remedies that should be resorted to. We usually prefer hyoscyamus.

III. As regards other remedies, we sometimes give cod-liver oil in those cases were rheumatic pains seem to exist. As regards dietetic rules, nutritious food, and a little wine and ale (*not containing strychnine*), are to

be prescribed. The patients should take moderate exercise in the open air.

Prognosis and Treatment of Paraplegia due to Chronic Meningitis.—The prognosis of this affection is nearly the same as that of chronic myelitis, with this difference, that the paralysis may be more completely cured after a meningitis than after a myelitis.

The treatment of chronic meningitis is almost the same as that of chronic myelitis, with the following exceptions: 1st. Blisters ought to be the principal means employed in cases of meningitis: every fortnight a new one should be applied, while the preceding one is drying up. 2dly. Iodide of potassium, in doses of six grains twice a day, is to be preferred to ergot and belladonna, in cases of chronic meningitis. If there are signs of considerable effusion, diuretics should be used in conjunction with the iodide.

Prognosis and Treatment of Paraplegia due to a Congestion of the Spinal Cord and its Membranes.—This affection is much less fatal, and much easier to cure completely, than myelitis or meningitis. However, when the paraplegia due to congestion is of long standing, it is almost as difficult to cure as paralysis due to meningitis.

The same general rules are to be followed in the treatment of congestion as in that of inflammation of the spinal cord and its meninges. Internally, at the same time, ergot of rye, belladonna, iodide of potassium, and sometimes diuretics, should be used. Externally the

cold shower bath should be employed rather than the hot douche, or any other revulsive; and if the shower bath cannot be borne, alternate applications of two sponges, one with very cold water, the other with hot water, should be made every morning all along the spine.

LECTURE IV.

SYMPTOMS AND TREATMENT OF VARIOUS FORMS OF PARAPLEGIA DUE TO WHITE SOFTENING, HEMORRHAGE, TUMORS, ETC.—GENERAL REVIEW OF THE SYMPTOMS OF PARAPLEGIA AND CONCLUSIONS OF THE COURSE.

Symptoms and diagnosis of the white softening of the spinal cord, and of the hemorrhage in this organ.—Prognosis and treatment of paraplegia due to softening of, or hemorrhage in, the spinal cord.—Symptoms and treatment of paraplegia due to hemorrhage in the vertebral canal.—Causes of the variety in the symptoms of tumor upon the spinal cord.—Frequency of myelitis in cases of tumor in or upon the cord.—Symptoms, diagnosis, and treatment of paraplegia due to a tumor.—Statistics showing the relative frequency of the various forms of paraplegia in men and women at different ages.—Signification of the various symptoms of paraplegia, or coexisting with it.—Cramps, twitchings, &c.—Referred sensations in the paralyzed limbs.—Feeling of tightness round the body or lower limbs.—Alterations in nutrition of paralyzed parts.—Erection of the penis.—Temperature of the paralyzed lower limbs.—Degree of paralysis of lower limbs, &c.—Anæsthesia and hyperæsthesia.—Reflex power.—Classification of the various forms of paraplegia.—Mode of action of the various remedies employed in paraplegia.—General conclusions as regards the nature, diagnosis, and treatment of the various forms of paraplegia.

GENTLEMEN: The most frequent cause of paralysis of the lower limbs is certainly an inflammation of the spinal cord. The cause of paraplegia which comes next as regards frequency is the white or non-inflammatory softening. This affection is produced in the spinal cord in a similar manner as in the brain, *i. e.*, in most cases as a consequence of an alteration of the bloodvessels, the walls of which do not allow that free interchange of matter between the nervous tissue and the blood, which

constitutes nutrition; or probably in some cases as a consequence of interruption in the circulation of blood by the presence of a clot in a bloodvessel, or the pressure caused by a tumor upon a bloodvessel. I shall not say more as regards the history of the morbid anatomy of the spinal cord in this affection, as my object is only to study the symptoms and the treatment of the various forms of paraplegia.

Usually patients attacked with the non-inflammatory softening of the spinal cord at first complain only of weakness. They gradually become weaker, although their general health may seem to be as good as ever. They feel the weakness especially at the knee and ankle-joints; they find it very difficult to go up or down stairs, to go in or out of a carriage, and their gait becomes tottering, especially when they cannot direct their movements with the help of the sight. When lying down, if they see the lower limbs, they can move them pretty freely, but without force. After a time the paralysis becomes much more marked, and then sensibility in the whole length of the lower limbs and the power of the will over the bladder and the rectum are also found much diminished. There is no pain, or hardly any, in the spine or paralyzed parts. Very rarely is the urine altered. The temperature of the lower limbs is often higher than it is in health, especially when the paralysis is complete or nearly so.

We will refer to the preceding lectures for the diagnosis between the form of paraplegia depending upon the non-inflammatory softening of the spinal cord and

the reflex paraplegia, or the forms of paraplegia due to myelitis, meningitis, or congestion of the spinal cord and its meninges. As regards the other forms of paraplegia, their diagnosis from that caused by softening of the cord will be indicated in another part of the lecture. We will merely say here that the absence of cramps, of pain in the spine and lower limbs, and of several other symptoms of disease of the spinal cord or its membranes, will help more for the diagnosis of the non-inflammatory softening of this nervous centre than the symptoms which we have described as existing in this affection.

Hemorrhage in the Gray Matter of the Spinal Cord.— Paraplegia due to this cause is characterized by the suddenness of its production, by a pain at the part of the spinal cord where the hemorrhage occurs, owing, probably, to the distension of the posterior roots of the nerves in the gray cornua, by a pain in the spine after pressure upon it, and also by a pain in the parts of the body where are distributed the nerves originating from the part of the spinal cord which is the seat of the disease. The sphincters of the bladder and rectum are almost completely paralyzed from the very first.[1] It is not rare that an inflammation supervenes in the parts of the cord surrounding the clot, and then all the symptoms of myelitis occur.

[1] Very numerous cases of various kinds of disease of the spinal cord which I have analyzed lead to the view that the nerves of the rectum and of the bladder do not pass close to those of the sphincters of these organs in the spinal cord. The last nerves seem to be near the very centre of the gray matter, while the others seem to be chiefly in the white anterior columns.

According to the seat and the extent of the hemorrhage the symptoms vary extremely. If the amount of blood effused be very small, the symptoms may be very slight, and the patient may recover in a few months, as in a case recorded by Cruveilhier. If the amount of blood is considerable, it descends along the whole length of the central canal of the spinal cord, and also sometimes breaks through the gray cornua, especially the anterior ones. The loss of sensibility and of voluntary power is then complete, and the temperature of the paralyzed limbs is increased. If the hemorrhage is limited to one lateral half of the gray matter—as in a most interesting case recorded by Monod, and in another by Mr. Oré[1]—there is loss of movement in the side of the hemorrhage, and loss of sensibility in the opposite side.

It is a remarkable feature of paraplegia due to hemorrhage in the gray matter of the spinal cord, that a diminution of sensibility is always one of its first symptoms; and that when the whole of the gray matter is altered by the effused blood, the anæsthesia is complete.[2]

Diagnosis of the Hemorrhage in the Spinal Cord.—The suddenness of the production of paraplegia is almost sufficient to show that it is due to effused blood, but it remains to decide whether the blood is in the tissue of the spinal cord, or in the vertebral canal, outside of this nervous centre. In this last case, there is more pain in

[1] I have given a summary of these two cases in my "Lectures on the Central Nervous System." Philadelphia, 1860, p. 96, Cases 30 and 31.

[2] See the above-quoted Lectures, p. 87.

a great extent of the spine than in the preceding; and also tetanic convulsions are not rare when the blood is effused outside of the spinal cord; while a hemorrhage in the cord has never produced convulsions, so far as I know. Besides, there is more marked anæsthesia in cases of effusion of blood in the tissue of the spinal cord than outside of it.

It is usually very easy to distinguish a hemorrhage in the spinal cord from a white softening of this organ. The suddenness of the production of the paralysis and the existence of the pains will sufficiently characterize the first of these affections; and in those cases of almost sudden paraplegia, owing to softening, the absence of pains (in the spine, &c.) will serve to distinguish this form of paraplegia from that due to a hemorrhage. I need not say that these two affections—*i. e.*, softening and hemorrhage—do not rarely coexist. This coexistence will not be surprising to any one who knows that in the spinal cord, as well as in the brain, the same morbid condition of bloodvessels is usually the cause of both these affections.

Prognosis of Paraplegia due to White Softening or Hemorrhage in the Spinal Cord.—The great indication for the prognosis in cases of softening or hemorrhage in the spinal cord is the extent and degree of the paralysis. A softening limited to the lower part of the dorsal region of the spinal cord may admit of a very prolonged duration of life. A hemorrhage is a more grave affection than a softening, because there is always a great chance of its being reproduced, and also because the blood

effused may cause very extensive alterations. We do not know a single case of complete cure of paralysis of the lower limbs caused by softening or hemorrhage in the spinal cord; but, as far as diagnosis not confirmed by autopsy may be relied on, we can say that we have seen many cases of non-inflammatory softening of the spinal cord arrested in their development; and, still more, that in five or six cases a very notable amelioration has taken place.

Treatment of Paraplegia due to White Softening of the Spinal Cord.—The treatment of this affection ought to be pretty much the same as that of hemiplegia caused by a non-inflammatory softening of the brain. We will not enter here into the discussion of the various modes of treatment which have been proposed or employed in this last case; we will only mention the general plan of treatment we have employed with some appearance of success in many cases of softening of the spinal cord.

1st. Iodide of potassium is the principal of the remedies that may be relied upon. We generally employ it in doses of five grains twice a day, mixed with nearly the same doses of sesqui-carbonate of ammonia, in a decoction of cinchona bark, or an infusion of calumba or rhubarb. We insist upon the importance of taking this mixture before food in the morning and an hour before dinner, to avoid the decomposition of the iodide by the gastric juice and the setting free of the iodine, which sometimes takes place, and causes a gastric disturbance, erroneously attributed by some practitioners to the iodide itself.

2d. Besides the preceding remedy, we prescribe various tonics, such as iron and cinchona-bark wine.

3d. Strychnine may be employed with some profit in those cases where the paralysis is slight; but it must be remembered that, on account of the congestion produced by the large doses of this alkaloid in the spinal cord, there would be danger in making use of it in cases where, the paralysis being complete, or nearly so, there is reason to think that the bloodvessels of the spinal cord are much altered, and that therefore a hemorrhage might be the consequence of the action of strychnine. I need hardly say that those remedies which diminish the amount of blood in the spinal cord (such as belladonna, ergot of rye, &c.), should not be employed in this form of paraplegia.

4th. Besides the use of some of the above remedies, I recommend, as an excellent means of improving the nutrition of the spinal cord, the daily use of the cold douche or the cold shower bath applied to the spine. Sea-bathing may also be of service.

5th. The patient should lie down flat on his back at night; he should live upon the most nutritious food, drink wine and beer in a moderate quantity, and take as much exercise in the open air as possible, without, however, exhausting his diminished power of motion. Shampooing and galvanism may be applied with profit to the paralyzed limbs.

Treatment of Paraplegia due to Hemorrhage in the Spinal Cord.—The same rules are to be followed in cases of this kind of paralysis as in cases of softening of

the spinal cord, with these slight differences: that, 1st, three doses of iodide of potassium, instead of two (of five grains each), ought to be given every day; 2d, strychnine ought not to be employed; 3d, constipation, lying down on the back, and all other causes of congestion of the spinal cord, should be carefully avoided.

Symptoms and Treatment of Paraplegia due to Hemorrhage in the Vertebral Canal.—A hemorrhage between the spinal cord and its bony envelop is fortunately an event of rare occurrence. I have seen but one case of this kind of hemorrhage, which proved fatal in less than two days. The blood is effused either between the pia mater and the arachnoid, or (more rarely) between the dura mater and the vertebræ. The first symptom is usually a pain extending along the spine from the seat of the hemorrhage to the lower extremity of the vertebral canal. Almost immediately a complete paralysis of the lower limbs and very often tetanic convulsions appear. In almost all cases this hemorrhage is rapidly fatal, either in consequence of its influence upon the circulation or respiration, or, indirectly, in consequence of an acute and extensive meningitis. Our object being here to study paraplegia in its chronic forms, we will not say more upon the symptoms of this affection.

As regards the treatment of the hemorrhage in the vertebral canal, we will only say: 1st, that, at once, all the most active means usually employed in the various cases of visceral hemorrhage should be made use of; 2d, that the patient should be placed in bed on one side, and not on his back; 3d, that pounded ice should be

applied, in bladders, all along the spine; 4th, that if the patient survives several days, the same treatment as is above prescribed for cases of hemorrhage in the gray matter should be employed.

There is no affection of the spinal cord or its membrane that presents such varied symptoms as tumors. According to the seat of the tumor, there are symptoms of disease of the heart, the lungs, the walls of the chest or of the abdomen, lumbago, neuralgia, &c. The irritation of the anterior or the posterior roots of one or several pairs of the spinal nerves is the cause of these symptoms, and their variety depends upon the degree of irritation, and also upon the nerve that is irritated. In the beginning of the affection, besides some symptom owing to that cause, there is pain at the part of the spine where the tumor is situated. Usually, this pain is increased by pressure on the spine. When the disease progresses, myelitis, and sometimes meningitis, are produced. If it be myelitis, which is a very frequent occurrence, there are sensations of formication or of pricking, as if with pins and needles, in the paralyzed limbs; spasmodic movements or simple twitchings, or a great rigidity appear in those limbs; the urine becomes alkaline, and sloughs or bullæ are formed on the sacrum or the nates. The feeling of a cord tied round the body or round the paralyzed limbs is perceived. The pain in the spine notably increases.

If a meningitis is produced by the irritation of a tumor in the vertebral canal, there is a rapid increase of the paralysis; any movement of the spine or of the lower

limbs causes a very acute pain; the muscles of the back become rigid spasmodically, especially when the spine or the lower limbs are moved.

If no inflammation of the spinal cord or its membrane is produced by a tumor, the symptoms are very similar to those of a non-inflammatory softening, with this difference, that there is pain in the spine, and also the effects of the irritation of the pair or pairs of nerves, originating where the tumor lies in the vertebral canal. When the tumor has destroyed a part of the spinal cord, there are symptoms that vary according to the part so injured. If it be a lateral half of that organ, there is loss of voluntary movement in the corresponding limb, with conservation of sensibility, while in the other limb there are loss of sensibility and conservation of voluntary movement.[1]

I have lately seen a case of this kind, so far as I can judge from the symptoms. Several periostic (syphilitic) tumors appeared, one after the other, on the head and face of a gentleman, who, on their disappearance, was attacked with paraplegia, apparently caused by a similar tumor pressing upon the right side of the spinal cord, and producing paralysis in the lower limb of that side and anæsthesia in the left lower limb.

If the gray matter of the cord be the original seat of a tumor, there are at first numbness and diminution of the power of the will over the bladder, with weakness of the lower limbs. Afterwards, paralysis becomes evident

[1] Several cases of this kind have been published. See my "Lectures on the Central Nervous System," Philadelphia, 1860, pp. 93–111.

in these limbs, and anæsthesia, in a much more marked degree than usual in diseases of the spinal cord, is observed, together with a loss of the power of directing movements.

If the posterior columns of the spinal cord are alone pressed upon by a tumor, there is at first hyperæsthesia, with but a slight diminution of the voluntary movements in the lower limbs; afterwards, when the pressure reaches the gray matter, diminution of sensibility and of the power of the will over the bladder, and increase of the paralysis of the lower limbs. A very interesting symptom—*i. e.*, the loss of the power of guiding the movements of the lower limbs—may be observed in cases of a tumor pressing upon the lower extremity of the spinal cord on its posterior surface. There may be in such cases no real paralysis, or at least all the movements of the various parts of the lower limbs are possible, *so long as the patient can see them;* but when he tries to move these limbs in the dark, or when he does not look at them, he cannot succeed in making the movement he wishes to perform. Besides, he does not know where his feet or legs are, unless he looks at them or touches them with his hands. He may be able to stand on his feet when he sees them; but if he ceases to look at them, he is at once in danger of falling down. This condition depends upon the alteration of some of the posterior roots of nerves, and of the posterior white and gray parts of the spinal cord, producing partial anæsthesia of the skin and muscles of the feet and legs. I have now a case of this kind under my care.

In cases of tumor in or upon the spinal cord, epileptiform convulsions have often been observed. Sometimes, also, real epileptic fits, with loss of consciousness, biting of the tongue, foaming at the mouth, &c., are produced in such cases.[1] This is what has been erroneously called *spinal epilepsy.*

I need not say that the nature of a tumor will sometimes serve for the detection of its existence. A cancer, by the general symptoms it causes, will give some additional ground to the supposition that there is a tumor in the spinal canal. If the patient is consumptive, and if the paraplegia has been slow in its development, there is some probability that the tumor supposed to exist in the spinal cord is a tubercle.

Diagnosis of Paraplegia due to a Tumor of the Spinal Cord.—The only affections which might be mistaken for this kind of paraplegia are meningitis and myelitis. A very limited meningitis localized in the upper part of the dorsal region, or in the cervical region, might give rise to pretty nearly all the symptoms of a tumor of the spinal cord: local pain (spontaneous and after pressure); sensations of heat or cold, or pricking, &c., in the peripheric part of the nerves, originating where the meningitis or the tumor exists; spasmodic twitchings in the muscles animated by these nerves, &c. In a case of meningitis so localized, there is paralysis of the lower limbs, on account of the effusion which presses upon the spinal cord in its lower extremity; and the same cause

[1] See my "Researches on Epilepsy," p. 11.

that produces a paralysis diminishes the reflex power of the dorso-lumbar part of the spinal cord. On the contrary, the whole of the cord below the seat of a tumor, remaining healthy and being separated from the brain, acquires a very energetic reflex power, and the least excitation produces reflex spasms or convulsions in the lower limbs.

Between cases of tumor upon the lumbar part of the spinal cord, and cases of meningitis limited to the lumbar part of the meninges, the diagnosis is extremely difficult. However, there are more spasms in the muscles of the limbs in the case of a tumor, and more in the muscles of the back in the case of meningitis. Besides, in this last case, the affection would often begin by acute symptoms—fever, &c.; and the paralysis would soon extend to other muscles than those of the lower limbs.

We have described, in Lecture II., the various symptoms of myelitis localized in the upper part of the dorsal region or higher up. It is not very difficult to distinguish this affection from the paraplegia due to a tumor, so long as no degree of inflammation has been produced in the spinal cord by the irritation of the tumor. Amongst the characteristic symptoms which would not be observed in the lower limbs, if there is a tumor and no inflammation of the spinal marrow, are all the referred sensations of pricking, formication, cold and heat, &c. But if a local myelitis is produced by a tumor in the upper part of the dorsal region, or higher up, leaving all the lower part of the cord healthy, the symptoms will be the same as those of a localized myelitis without a

tumor. It is only by the mode of beginning of these two affections that it would be possible to distinguish one from the other. In the case of myelitis without a tumor, various sensations and cramps in the lower limbs would have existed from the very commencement; while in the case of a tumor preceding myelitis there would be none of these symptoms in the lower limbs.

Prognosis of Paraplegia due to a Tumor of the Spinal Cord.—We need not speak of the gravity of paraplegia caused by a cancer or a tubercle. The chances of cure, or even of a notable amelioration, when other kinds of tumors, except one, press upon the spinal cord, are almost null. But it is well to know that the duration of life may be prolonged many years, and the degree of paralysis may remain very long unchanged. Tumors owing their origin to syphilis form an exception to the above rule. A cure is possible, and generally a notable amelioration will be observed after the proper treatment is continued long enough. However, even in cases of this kind, if the injury to the spinal cord is considerable, the cure of course cannot be complete, and the amelioration cannot be very great.

Treatment of Paraplegia due to a Tumor of the Spinal Cord.—The rules to be followed may be reduced to three:—

1st. The congestion and the tendency to inflammation ought to be treated by the same means that should be employed in cases of myelitis. In a patient now under my care, who has all the symptoms of a cancerous tumor in the middle of the dorsal region, and who is completely

paraplegic as regards voluntary movement, sensibility, and power over the bladder and rectum, I have succeeded in diminishing the pain in the back and the referred pain in the lower limbs, and also the spasms of the paralyzed muscles, by the application of a large belladonna plaster on the back, and by the internal use of ergot of rye and belladonna. If there are symptoms of meningitis, together with those directly due to a tumor, the patient must take iodide of potassium, besides the other remedies just named. The spasmodic rigidity of the lower limbs, or the wasting of the muscles, in the rare cases where there is no cramp, no convulsions, and no spasmodic rigidity, requires the application of shampooing or galvanism to the muscles of the lower limbs. Dry-cupping on the painful spot of the spine, or other modes of revulsion, may be found useful to diminish the pains and spasms, and also to prevent a rapid progress of the disease. Strychnine should be avoided, as it would certainly increase both the pains and the spasms.

2dly. If there is a probability that the tumor is of a syphilitic nature, iodide of potassium, in larger doses than if there were a simple meningitis, should be the principal remedy; five grains three times a day is the dose I have employed, with marked benefit, in two cases of this kind. This remedy ought to be taken for at least six months. Against the pain in such a case, I employ aconite rather than belladonna, both externally and internally (from five to ten minims of the tincture a day internally). But I make use of ergot of rye as much as in other cases of tumor. If there is the appearance

that the tumor is a tubercle, cod-liver oil is to be given. It cannot prove injurious, even if the paraplegia is not due to a tubercle, and it may diminish the pain.

3dly. The patient ought to have the most nourishing diet, and a little wine. He ought to take exercise in the open air, and drive if he cannot walk. In bed, he should lie on one side of the body, and not on the back. His appetite and digestion ought to be carefully watched, and kept right by tonics, aperients, &c.

Relative Frequency of the Various Forms of Paraplegia in Men and Women at different Ages.—Before entering into the discussion of the general characteristics of the various forms of paraplegia, we will give here some statistical accounts that may be found interesting. The facts on which these accounts are grounded have all been observed by myself. We have left aside not only all the cases of paraplegia in which there were doubts as regards the diagnosis, but also those cases about which we have not kept at least a few notes.

The following table shows the relative frequency of the various forms of paraplegia in men and women:—

	Men.	Women.	Total.
Myelitis[1]	35	9	44
Non-inflammatory softening	26	8	34
Reflex paraplegia	19	7	26
Congestion	8	5	13
Tumor or pressure upon the cord	7	2	9
Spinal meningitis	6	1	7
Hemorrhage	5	2	7
Hemorrhage followed by myelitis	4	1	5
Hysterical paraplegia	...	5	5
	110	40	150

[1] Simple myelitis in most cases; in the other cases, myelo-meningitis.

These facts show that the most frequent causes of paraplegia are the inflammation and the non-inflammatory softening of the spinal cord. Next in importance, as regards frequency, is the reflex paraplegia. The most remarkable feature of this table is that paraplegia is much more frequent in men than in women. This conclusion is borne out also by the cases about which we have not come to any positive diagnosis; out of 27 of such cases, 18 were men, and 9 women; so that, in all, the cases of paraplegia in which we have noted the sex, amount to 177, of which 128 were men and only 49 were women.

As regards the age at which paraplegia begins, we have notes of 156 cases, showing that it may appear at any age, but that certain forms belong more to certain ages than to others. For instance, reflex paraplegia is the most common form in children, myelitis is the most frequent cause of paraplegia in adults, and non-inflammatory softening the predominant cause of this paralysis in old age.[1]

Signification of the Various Symptoms belonging to, or coexisting with, Paraplegia.—We have given many details as regards these symptoms in our descriptions of the reflex paraplegia (Lects. I. and II.); of myelitis, meningitis, and congestion of the cord and its meninges (Lect. III.); of the non-inflammatory softening, hemorrhage, and tumors (Lect. IV.). We will now take up

[1] The number of cases of paraplegia now under my care or that of my colleague, Dr. Ramskill, at the National Hospital for Paralytics and Epileptics, is already pretty near 100; and as every day new cases are coming in (as out-patients), we shall soon have the elements of good statistics.

each of the most important symptoms, and show to what form of paraplegia it is especially attached, and what is its cause.

1st. *Cramps, Twitchings, and other Convulsions.*—The signification of tonic or clonic convulsions in paralyzed muscles, in cases of paraplegia, is quite evident: they are incontestable results of an irritation of either the anterior roots of the spinal nerves, the spinal cord, or the sensitive nerves in any part of their length, through a reflex action. In cases of myelitis it is chiefly under the form of cramps that convulsions occur; the frequency of these spasms is one of the characteristics of this affection. In cases of tumors pressing upon the spinal cord, especially upon its posterior surface, cramps are not so frequent as twitchings or a general spasm producing a drawing up of the lower limbs, which sometimes remain permanently in a state of spasmodic flexion. In cases of chronic meningitis or congestion of the spinal cord or its membranes, twitchings are more frequent than cramps. In cases of reflex paraplegia, the external irritation that produces the paralysis sometimes produces also spasmodic movements by a reflex action. Especially in those cases where the rectum or the urethra are the parts from which starts the irritation, there is what the patient calls a *catchiness* or a drawing up of the legs. In cases of hemorrhage in the spinal canal, tetanic convulsions are frequently observed. Rigid spasms of the muscles of the back are amongst the most prominent symptoms of spinal meningitis. Amongst the affections of the spinal cord that

produce paraplegia, one of the most frequent—the non-inflammatory or white softening—is characterized by a total absence of cramps, twitchings, or other convulsions.

On the whole, some form of morbid muscular contractions exists constantly in myelitis or spinal meningitis, and frequently in cases of congestion of the spinal cord or its membranes, or of tumors or other cause of pressure upon the spinal cord, and also, sometimes (by a reflex action), in cases of reflex paraplegia. On the other hand, a complete absence of morbid contractions will be observed in all cases of non-inflammatory softening, and in the majority of cases of reflex paraplegia.

2d, *Referred Sensations in the Paralyzed Limbs.*—These morbid sensations, like morbid contractions, are the results of some kind of irritation, and, as we have tried to prove in Lect. III., the vital properties of the spinal cord changing when it is inflamed, these sensations may be produced by an inflammation of the gray matter. The various kinds of conductors passing through or along the gray matter being then irritated, give origin to all kinds of sensations which are *referred* to the various parts of the lower limbs. Sensations of cold or of heat, of touch (formication, tickling, pressure, tightness, &c.), of pain (pins and needles), and also sensations arising from muscles, and giving the idea that the limbs are in a different position from that in which they really are—in fact, all the sensations that pressure or some other cause of irritation may produce when applied to the ulnar or the sciatic nerves—are often observed. In myelitis, some of these sensations always

exist; in meningitis, or when there is simply a congestion of the spinal membranes, most of them are also observed, but less intense than in myelitis. In cases of irritation of the posterior roots of nerves by a tumor or a displaced bone, &c., referred sensations exist also. In such cases of irritation by a tumor, &c., and also in cases of congestion or meningitis, there is a feature which distinguishes these affections from myelitis: it is that in this last affection there may be a reference of sensations to all the parts of the body that receive their nerves from the part of the spinal cord which is below the upper limit of the inflammation, while in the three other affections the sensations are referred only to those parts of the body which receive their nerves from the part of the spinal cord at the level of the seat of the irritation. The non-inflammatory softening, a hemorrhage, or a tumor in the gray matter (as long as they do not produce inflammation), and also the reflex paraplegia, are characterized by the absence of referred sensations.

3d. *Feeling of Tightness round the Body or round the Lower Limbs.*—This sensation, which is so frequent in myelitis, exists also, sometimes, in cases of tumors, of congestion of the spinal cord, and in meningitis. It is absent in cases of non-inflammatory softening and of reflex paraplegia.[1] From this last fact it results that

[1] I need not say that this symptom, as well as many others depending upon a degree of irritation of the spinal cord or its nerves, will be observed in cases of reflex paraplegia, or of non-inflammatory softening of the spinal cord, if in those cases there is some degree of congestion in the membranes or in the cord above the softened part, or that which causes the reflex paralysis.

the tightness across the chest or the abdomen, at the level of the upper limit of the paralysis, does not depend, as has been said, upon the effort made in moving the paralyzed parts by the non-paralyzed muscles just above them. Another objection to this explanation is, that the same feeling which exists around the body exists also, sometimes, around the lower limbs, in myelitis. The most probable mode of production of this strange feeling is, that it is due to some irritation of sensitive nerve-fibres in the spinal canal producing a sensation referred to the periphery of the body (abdomen, chest, or limbs).

4th. *Alterations in the Nutrition of Paralyzed Parts.*—These alterations chiefly depend upon an irritation of the spinal cord or its nerves. It is principally in myelitis that they are observed. A rapid wasting of the paralyzed muscles, the production of bullæ or sloughs over the sacrum, the nates, &c., are the most frequent results of an irritation of the vaso-motor or of the other nerves that have an influence upon the nutrition of the lower half of the body. These alterations are not observed in cases of reflex paraplegia, or of non-inflammatory softening of the spinal cord; neither do they exist in cases of hemorrhage, or of a tumor in the gray matter, unless an inflammation is produced.

5th. *Erection of the Penis.*—This is another symptom showing an irritation of the spinal cord or its nerves. It exists frequently at night, and sometimes in the daytime, in cases of myelitis or congestion of the spinal meninges. It is also observed, but less frequently, in

cases of meningitis, of tumor upon the spinal cord, of hemorrhage in the spinal canal (outside of the cord), and sometimes even in the reflex paraplegia, but then only on the introduction of a catheter, or in consequence of some peripheric irritation. This symptom does not exist in cases of non-inflammatory softening, or of hemorrhage, or a tumor in the gray matter of the spinal cord.

6th. *Temperature of the Paralyzed Lower Limbs.*—In those affections in which there is an irritation of the spinal cord or its membranes (congestion, myelitis, meningitis, pressure on the cord by effused blood, a tumor, or a displaced bone, &c.), the lower limbs, and especially the feet, are almost constantly very cold. This symptom is the consequence of the irritation of the vaso-motor nerves, which produces a contraction of the muscular fibres of bloodvessels, just as the irritation of the nerves of the muscles of the legs, feet, &c., produces cramps, twitchings, &c. In the reflex paraplegia, the feet are also sometimes very cold, in consequence of a reflex contraction of their bloodvessels. In cases of non-inflammatory softening of the lumbar enlargement of the spinal cord, with a complete loss of the vital properties of this part, the lower limbs are almost constantly very warm, as a result of the paralysis of the vaso-motor nerves.[1]

7th. *Degree and Extent of Paralysis of the Lower Limbs, the Bladder, and the Rectum.*—Of course, great

[1] See my "Lectures on the Central Nervous System," Philadelphia, 1860, Lectures X. and XI.

differences exist as regards the degree and extent of the paralysis, according to the degree and extent of the alterations in the spinal cord. We do not intend entering into any details on this subject. We wish only to say here that—1st, as regards *the mode of appearance of the paraplegia*, if it be sudden it is almost always due to a hemorrhage, either in the cord or outside of it; 2d, as regards *the degree of the paralysis*, it is equal in all the muscles of the lower limbs, if the alteration occupies the whole of the lumbar enlargement or is above it, except in cases of reflex paraplegia, where some muscles may be much more affected than others; 3d, as regards *the changes in the degree and extent of the paralysis*, they are rapid and frequent in cases of reflex paraplegia, of chronic meningitis with effusion, and of spinal congestion, while, on the contrary, they are slow and rare in cases of myelitis, tumors, and non-inflammatory softening; 4th, as regards *the paralysis of the bladder and of the rectum*, they exist more frequently in cases of myelitis, of non-inflammatory softening, or of hemorrhage in the gray matter, than in the reflex paraplegia, or in cases of tumor, of congestion, or even meningitis.

8th. *Anæsthesia and Hyperæsthesia.*—Myelitis existing most frequently in the gray matter, anæsthesia (*i. e.*, either or all of its different kinds, with the loss of the power of guiding the voluntary movements) is one of the ordinary symptoms of this affection. This symptom is less frequent or less intense in most other cases of paraplegia, except, of course, a hemorrhage in the gray matter. As regards hyperæsthesia (*i. e.*, a morbidly in-

creased insensibility), it is frequent in cases of incomplete paraplegia, when the posterior columns of the spinal cord, in a small part of their length, are destroyed, either by a tumor or by a softening (inflammatory or not). It often exists, also, in cases of congestion of the spinal meninges.[1]

9th. *Reflex Power.*—In all cases of paraplegia in which the lumbar enlargement of the spinal cord remains uninjured, the reflex power of that enlargement increases notably. On the contrary, the reverse is observed in cases of alteration of this enlargement, and especially when it is atrophied or disorganized, in consequence of an inflammatory or a white softening. In meningitis with effusion, in lumbar myelitis, etc., the loss of reflex power is sometimes so complete, that there is no movement at all excited by the tickling of the sole of the foot; while, on the contrary, in cases of myelitis or of a tumor above the dorso-lumbar enlargement, the least touch of the sole of the feet, any irritation of the rectum by fecal matters, of the bladder by urine, of the urethra by a catheter, etc., may produce the most powerful reflex movements. (See Lecture III., *Myelitis*, and Lecture IV., *Tumor of the Spinal Cord.*) The same thing would be observed in cases of hemorrhage in the gray matter above the dorso-lumbar enlargement.

Any one who will take the trouble of reading the preceding review of the principal symptoms which may coexist with paraplegia, will at once find that a broad

[1] See my above quoted Lectures, for the symptomatic value of anæsthesia and hyperæsthesia.

line of demarcation may be traced between the most frequent forms of paraplegia. In the various cases in which there is an increase in the amount of blood in the spinal cord or its membranes (myelitis, meningitis, or simple congestion), symptoms appear which clearly indicate that there is such an increase. These symptoms are the consequence of an irritation of a part of the spinal cord, or of the roots of some of the spinal nerves. They may be classified as follows:—

1st. *Symptoms of irritation of motor nerve-fibres—i. e.*, convulsions, cramps, twitchings, erection of the penis, &c.

2dly. *Symptoms of irritation of sensitive nerve-fibres—i. e., referred sensations*, such as formication, itching, pricking and other pains, abnormal feelings of cold or heat, of tightness, pressure, &c.

3dly. *Symptoms of irritation of vaso-motor or nutritive nerve-fibres—i. e.*, diminution of temperature of the paralyzed limbs, wasting of muscles, œdema, bed-sores, alkalinity of urine, &c.

Cases of paraplegia in which the nutrition of the spinal cord or the amount of blood in the vertebral canal is diminished are characterized by the absence of the above symptoms. Such is the paraplegia caused by the white or non-inflammatory softening of the spinal cord; such is also, generally, the reflex paraplegia.[1]

There are, therefore, two distinct groups of cases of paraplegia: one characterized by symptoms of irritation

[1] We think it may be necessary to repeat here that some symptoms of irritation (twitchings, extreme coldness of the feet, &c.) may occur by a *reflex action* in the reflex paraplegia.

of the various kinds of nerve-fibres existing in the spinal cord or the roots of its nerves; and another characterized by the absence of these symptoms. Most of the cases of paraplegia belong to one or the other of these groups. But there are some cases, such as those caused by a hemorrhage or a tumor, which may form a third group, in which the symptoms of irritation may be almost entirely absent, or in which only some of these symptoms exist, and with peculiar features, as we have already shown.[1]

Leaving aside this third group of cases of paraplegia, the treatment of which has been indicated in the beginning of this Lecture, we find that most cases of this form of paralysis may be ranged into two groups—1st, cases in which there are symptoms of irritation, with an increased amount of blood in the spinal cord or its membranes; 2d, cases in which there is an insufficiency of nutrition, and most frequently an insufficiency in the amount of blood in the spinal cord, and also no symptoms of irritation. This division leads to the establishment of the following rules of treatment:—

1st. In those cases of paraplegia in which there are symptoms of irritation, employ those means of treatment that diminish the amount of blood in the vertebral canal.

2d. In those cases of paraplegia in which there are no symptoms of irritation, employ those means of treat-

[1] See the beginning of this Lecture: "Hemorrhage in the cord and in its membranes; tumor upon or in the spinal cord."

ment which increase nutrition and the amount of blood in the spinal cord.

We are now led to examine by what means these two effects may be obtained—*i. e.*, to increase or diminish the amount of blood or the nutrition of the spinal cord. With the above rules in view, we will say a few words on each of the various means of treatment that are known to have been employed successfully in cases of paraplegia.

1. *Belladonna.*—This most powerful remedy has been employed quite blindly in the various forms of paraplegia by French and Italian physicians. The *rationale* of its mode of action is generally so little known, that it is often prescribed in those cases in which, instead of being useful, it increases the paralysis. An eminent author of a very learned work on Therapeutics and Pharmacology declares that "it is quite obvious that it (belladonna) should never be employed in cases dependent on congestion, inflammation, or organic lesion of the nervous centres, until this condition shall have ceased entirely, and nothing left but inertness." The truth is, that it is precisely in cases of congestion or inflammation of the spinal cord or of its membranes that belladonna should be used against paralysis. The mistake made by this most able writer depends in a measure upon the general but erroneous opinion that belladonna is a stimulant of the nervous centres. We will not speak here of its action on the brain; but as regards the spinal cord and the spinal nerves, belladonna, far from being a stimulant, acts in diminishing the vital properties of these organs.

As we have already said,[1] belladonna is a powerful excitant of bloodvessels, and especially of those of the spinal cord and its membranes. In consequence of this influence, it diminishes the amount of blood in the vertebral canal, and in so doing produces a relative diminution of the vital properties of the spinal cord and its nerves. It is, therefore, in those cases in which these vital properties are increased that belladonna should be employed. We will sum up the indications to use or to avoid belladonna in saying:—

1st. Belladonna is one of the most powerful and reliable remedies that we may employ, in cases of paraplegia with symptoms of irritation of the motor, sensitive, and vaso-motor or nutritive nerve-fibres of the spinal cord, or of the roots of its nerves; in other words, in cases of congestion, meningitis, or myelitis.

2d. Belladonna is a most dangerous agent, able only to increase the paralysis, if employed in cases of paraplegia without symptoms of irritation, such as cases of white softening, or of the reflex paraplegia.[2]

2. *Ergot of Rye.*—This powerful remedy has also been employed quite blindly, although its mode of action being better known than that of belladonna, it would have been easier to discern in what cases of paraplegia it is able to be of benefit. Ergot, like belladonna, produces a contraction in the bloodvessels of the spinal cord and

[1] See Lecture II., treatment of the reflex paraplegia; and Lecture III., treatment of myelitis, meningitis, and congestion of the spinal cord and its meninges.

[2] We have pointed out the only exception to the above rule in the part of Lecture II. that relates to the treatment of the reflex paraplegia.

its membranes, and, therefore, diminishes the amount of blood circulating in these organs. The following is a summary of the indications and contra-indications to its use:—

1st. Ergot must be employed in cases of paraplegia with irritation of motor, sensitive, or vaso-motor nerves —*i. e.*, in congestion or inflammation of the spinal cord or its meninges.

2d. Ergot must be avoided as an agent only able to increase the paralysis in cases of paraplegia without symptoms of irritation, such as cases of the reflex paraplegia, or of non-inflammatory softening of the spinal cord.

3. *Strychnine.*—This most powerful remedy is also employed indiscriminately. I know of a large number of patients whose paralysis has been increased by the influence of this medicine. Its mode of action, as we have shown in Lectures II. and III., consists in increasing the amount of blood in the spinal cord and its membranes, and, as a consequence, in increasing the vital properties of that nervous centre. Therefore—

1st. Strychnine ought to be employed in those cases of paraplegia in which there is no sign of irritation, or of increase of the vital properties of the spinal cord, such as the cases of reflex paraplegia and of white softening of the spinal cord.

2d. Strychnine ought to be avoided as a most dangerous poison in those cases of paraplegia in which there are signs of congestion or inflammation of the

spinal cord or its meninges. In those cases, strychnine can only increase the cause of the paralysis.

4. *Sulphur.*—The *modus agendi* of this medicine in paraplegia is not well known, but it is at any rate certain that sulphur may be employed with advantage in cases of reflex paraplegia or white softening of the spinal cord, in which there is no irritation of this nervous centre. My own experience confirms the assertions of Graves in that respect.

5. *Phosphorus.*—The mode of action of phosphorus is still less known than that of sulphur. German physicians have successfully made use of this agent in paraplegia, probably in cases of insufficiency in the amount of blood in the spinal cord. We must say, however, that we have tried it without any benefit in two cases of white softening of the spinal cord.

6. *Mercury.*—No agent has been more extensively and more blindly used than mercury in cases of paraplegia. It is only in cases with an increased amount of blood in the spinal cord or its meninges that mercury may be used with advantage. Its depressing influence, however, is such, that I never employ it except in cases of syphilitic paraplegia. It is decidedly injurious in cases of white softening of the spinal cord, and also in cases of reflex paraplegia.

7. *Iodide of Potassium.*—This remedy is not sufficiently employed in paralysis. It is one of the most powerful agents of absorption of fluids effused in the cranio-vertebral cavity, either out of or in the substance of the nervous centres. It is the only known remedy

that may be employed without danger in the various forms of paraplegia. It is especially useful in cases of white softening of the spinal cord, due to the fatty degeneration of the bloodvessels of that organ. It has, more than mercury, the power of producing the absorption of effused fluids in the vertebral canal, and it is decidedly less depressing than mercury. In cases of syphilitic paraplegia, its curative influence is sometimes very rapid.

8. *Cantharides.*—This is another remedy, the mode of action of which is ignored, and which is employed blindly in any form of paraplegia. I have tried it without any apparent benefit in cases of paraplegia belonging to the two most distinct forms of this affection—*i. e.*, a case of white softening of the spinal cord, and a case of chronic meningitis. It seems, however, to have been useful in some cases of chronic myelitis.

9. *Stramonium, Hyoscyamus, and Indian Hemp.*—These agents act more or less like belladonna and ergot of rye on the bloodvessels of the spinal cord, and they are, therefore, to be used in those cases of paraplegia in which the amount of blood is increased in that organ. Of course, they must be avoided in cases of white softening or of reflex paraplegia. Against insomnia in cases of paraplegia with symptoms of irritation of the spinal cord, hyoscyamus or Indian hemp ought to be employed instead of opium, the use of which is then dangerous, as it produces a congestion of the spinal cord.

10. *Ammonia, Sulphate of Quinine, and Iron.*—These medicinal agents are sometimes of great service in para-

plegia. It is chiefly in cases of insufficiency in the amount of blood and in the nutrition of the spinal cord that they are to be employed; but they may be also used with benefit in cases of chronic myelitis or meningitis, or of spinal congestion, when the symptoms of irritation are not violent, if the pulse is weak and slow.

11. *Cod-liver Oil.*—Some cases of paraplegia have been reported in which cod-liver oil seems to have produced a very great amelioration. We have never employed it alone; but a notable amelioration has taken place in some cases of chronic myelitis in which we have employed cod-liver oil with belladonna and ergot of rye. In two of these cases, the patients had been treated for five or six weeks, without amelioration, by belladonna and ergot, and they began to get better only when cod-liver oil was added to the treatment.

12. *Bleeding and Cupping.*—The chronic inflammation of the spinal cord or its meninges does not require bleeding. Except in one case, we have never seen any decided good effect produced by bleeding in cases of paraplegia owing to chronic inflammation or to congestion. We hardly need say that any loss of blood might prove most injurious in cases of paraplegia in which there is diminution in the amount of blood in the spinal cord or of the nutrition of that organ, as in cases of white softening or of reflex paraplegia. Dry cupping frequently applied to the spine is an excellent means of treatment in those cases in which there is either an inflammation or a congestion in the spinal cord or its membranes. It

would rather be injurious than useful in cases of white softening or of reflex paraplegia.

13. *Blister*, *Moxa*, *Issue*, *Actual Cautery*, *&c.*—Revulsion, by these various means, is, to say the least, useless in cases of white softening of the spinal cord and of the reflex paraplegia. But these various means are often of great service in cases of myelitis or meningitis, especially when the inflammation is limited to a small extent in the length of the cord or its membranes.

14. *Cold and Hot Douche.*—The hot douche (at about 100°), applied *loco dotente* on the spine, is very useful in cases of inflammation or congestion, and useless, if not hurtful, in cases of reflex paraplegia and of white softening. As regards the cold douche, the cold shower-bath, sponging with cold water, &c., they are certainly most beneficial in cases of white softening or in the reflex paraplegia.

From the above review of the various means of treatment of paraplegia, it results—

1st. That in cases of paralysis of the lower limbs, with symptoms of irritation of the motor, sensitive, and vaso-motor nerve-fibres of the spinal cord or of the roots of its nerves, the proper treatment consists in the use of some of the following agents or means: Belladonna, ergot of rye, hyoscyamus, stramonium, Indian hemp, dry cupping, blisters, moxæ, issues, the hot douche, and also, sometimes, the iodide of potassium, ammonia, sulphate of quinine, iron, or cod-liver oil.

2d. That in cases of paraplegia without symptoms of irritation of the spinal cord or the roots of its nerves, the

rational treatment consists in the use of strychnine, sulphur, the cold douche or shower bath, and also of the iodide of potassium, and frequently ammonia, quinine, and iron.

As regards the principal, I might say the essential, agents to be employed against paraplegia, I can now repeat what I have so often said in these lectures, that it is of the utmost importance in the treatment of this affection not to make use of strychnine, belladonna, mercury, &c., before having ascertained positively whether there are or not symptoms of irritation of the spinal cord. Giving strychnine indiscriminately in all cases of paraplegia, as is done by so many practitioners, is a very dangerous mode of proceeding, as it may increase notably the disease to which the paralysis is due. The same thing may be said of the indiscriminate use of mercury, belladonna, cantharides, ergot, &c.

We will not say more here as regards the treatment of the various forms of paraplegia, as we have already discussed at length, in the beginning of this lecture and in the two preceding, the means of improving the nutrition of the spinal cord, of preventing the alterations of nutrition in the paralyzed limbs, in the bladder, &c., and also of diminishing the external irritation in cases of reflex paraplegia.

General Conclusions of the Course.

Our principal object in these lectures has been to show—

1st. That there is a form of paralysis of the lower

limbs entirely distinct from all others, as proved by its mode of production, by morbid anatomy, by its symptoms, and by the influence of a certain mode of treatment, and that this form of paralysis fully deserves the name of reflex paraplegia.

2d. That the reflex paraplegia may be caused by the most various irritations of the skin, the mucous and serous membranes, the abdominal or thoracic viscera, as well as of the genital organs, or the trunks of the spinal nerves.

3d. That most cases of paraplegia can be placed in two groups, entirely different one from the other, according to the existence or the absence of symptoms of irritation of the motor, sensitive, and vaso-motor nerve-fibres.

4th. That most of the therapeutical means to be employed in paraplegia are also to be grouped in two categories, one of which is fitted to those cases in which there are symptoms of irritation, and the other to those cases in which these symptoms do not exist.

